Medical Library

VOLUME 10 NUMBER 2

SEP 5 1929

ARCHIVES OF
OTOLARYNGOLOGY

EDITORIAL BOARD

GEORGE E. SHAMBAUGH, Chicago

ISIDOR FRIESNER, New York
CHEVALIER JACKSON, Philadelphia
EUGENE A. CROCKETT, Boston
ROBERT C. LYNCH, New Orleans

AUGUST, 1929

PUBLISHED MONTHLY BY AMERICAN MEDICAL ASSOCIATION, 535 NORTH DEARBORN STREET, CHICAGO, ILLINOIS. ANNUAL SUBSCRIPTION, $6.00

Entered as Second-Class Matter, January 14, 1925, at the Postoffice at Chicago, Illinois, Under the Act of March 3, 1879. Acceptance for mailing at special rate provided for in Section 1103, Act of October 3, 1917, authorized January 22, 1925

CONTENTS OF PREVIOUS NUMBER

JULY, 1929. NUMBER 1

Cytologic Examination of the Antrum: Review of Cases to Determine Relationship Between the Cytologic and the X-Ray and Pathologic Observations. Edward Cecil Sewall, M.D., and Leland Hunnicutt, M.D., San Francisco.

Herpes Laryngis. H. Robert Landon, M.D., New York.

Acute Suppuration of the Temporal Bone: Report of a Case. E. W. Hagens, M.D., Chicago.

Congenital Arteriovenous Fistula in the Tympanum. Ferris Smith, M.D., Grand Rapids, Mich.

Intracranial Complications Associated with Disease of the Sphenoid Bone. Report of Two Cases: (1) Meningitis Secondary to Infection of the Craniopharyngeal Canal (?) and (2) Abscess of the Frontal Lobe. J. G. Druss, M.D., New York.

The Relative Importance of Disease of the Nasal Sinuses as a Cause of Disease of the Optic Nerves. E. C. Ellett, M.D., Memphis, Tenn.

Ozena: Report of Cases. Joseph I. Kemler, M.D., Baltimore.

Clinical Notes:

- Adenoids in Adults: A Clinical Study. Roy F. Nelson, M.D., Oakland, Calif.
- The Treatment of Polypoid Sinusitis. G. Allen Robinson, M.D., New York.
- Report of a Case of Pipe Stem in the Left Main Stem Bronchus of a Child. T. E. Fuller, M.D., Texarkana, Texas.
- Zinc Ionization as a Treatment for Intermittent Nasal Obstruction. M. L. Harris, M.D., Brooklyn, N. Y.

Progress in Otolaryngology. A Summary of the Bibliographic Material Available in the Field of Otolaryngology from Jan. 1 to Sept. 30, 1928: The Paranasal Cavities. D. Campbell Smyth, M.D., Boston.

Abstracts from Current Literature.

Society Transactions:

- Vienna Laryngo-Rhinological Society.
- Austrian Otological Society.
- College of Physicians of Philadelphia, Section on Otology and Laryngology.

Book Reviews.

Directory of Otolaryngologic and Ophthalmologic Societies.

COPYRIGHT, 1929, BY THE AMERICAN MEDICAL ASSOCIATION

ARCHIVES OF OTOLARYNGOLOGY

VOLUME 10 AUGUST, 1929 NUMBER 2

TRAUMATIC CONDITIONS OF THE EAR IN WORKERS IN AN ATMOSPHERE OF COMPRESSED AIR *

HARRIS H. VAIL, M.D.
CINCINNATI

For ninety years, the condition known as caisson sickness or disease has been studied by many observers. In 1912, Hill [1] published the historic, physiologic, experimental and pathologic facts about caisson sickness.

In 1896, Alt [2] reported three severe cases of apoplectiform labyrinthitis in caisson workers. A workman, an hour after being subjected to a pressure of 2.2 atmospheres for more than two hours, experienced a sudden onset of severe pain in the ears, vertigo and absolute deafness. Another workman, within a few minutes after leaving the air lock, experienced the sudden onset of severe pains in the chest, serious collapse and total deafness. A third workman had cyanosis, dyspnea, deafness and marked vertigo.

In all of Alt's cases, the Weber test was referred to the ear less affected. The return of hearing was slight, and the tympanic membranes were not ruptured. However, he quoted a case reported by Moos, in which a caisson worker suddenly became deafened, with traumatic rupture of both tympanic membranes and bilateral hemorrhagic labyrinthitis.

In 1900, Heller, Mager and von Schrötter [3] divided their cases of ear trauma in caisson workers into two groups. The first group consisted of the cases of temporary deafness and vertigo caused by compression. The second group was composed of the cases which showed "Ménière's syndrome," and in which the aural lesions were thought to be due to nitrogen bubbles.

In 1909, Keays [4] reported 3,692 cases of caisson illness. Of these, vertigo without other symptoms was noted in 113, pains in the ears,

* Submitted for publication, June 7, 1929.

* Read at the Sixty-Second Annual Meeting of the American Otological Society, Atlantic City, N. J., May 22-24, 1929.

* From the Laboratory of Experimental Surgery, Medical College, University of Cincinnati.

1. Hill, Leonard: Caisson Sickness and the Physiology of Work in Compressed Air, New York, Longmans, Green & Company, 1912.

2. Alt, Ferdinand: Ueber apoplectiforme labyrinther Krankungen bei caisson Arbeitern, Monatschr. f. Ohrenh. Nasen- u. Rachenkrankh. **30**:341, 1896.

3. Heller, Mager and von Schrötter, quoted by Hill (footnote 1).

4. Keays, F. L., quoted by Hill (footnote 1).

hemorrhages from them and temporary deafness in 68, Ménière's symptom-complex in 14 and apoplectiform deafness in 2 cases.

In 1913, Boot [5] reported the case of a caisson worker who experienced vertigo and bilateral deafness one week after quitting work.

Boot reported another case in which bleeding from the nose and the left ear took place shortly after the worker emerged from the caisson. Later, vertigo and tinnitus appeared in the left ear.

In 1926, Damant [6] reported 30 moderately severe cases of caisson illness in 5,000 dives, but he did not mention any cases of deafness or ruptured ear drum membranes.

From the Bureau of Medicine and Surgery of the U. S. Navy I obtained a valuable contribution to the subject. In an answer to my inquiry, Capt. E. J. Grow, Medical Director, U. S. Navy, wrote me in 1929 as follows:

> A search of the records of the Bureau of Medicine and Surgery from 1924, to the present time fails to disclose a single admission to the sick list for damage to ears that could be considered due to diving activity.
>
> This, of course, cannot be construed to mean that there have not been instances of such injury. Rather, it would appear that such disability has been too trivial to warrant admission to the sick list, or else such injury was a complication of a more serious condition and therefore did not become a matter of record, except as a notation in the health record.
>
> In the case of an underwater fall, the tympanic membrane may be suddenly ruptured but the attendant "squeeze," which the diver experiences, is the serious condition for which the diver is admitted and returns made to the Bureau.
>
> It is singular that the records for 1924 and since show no admissions for ruptured tympanic membrane in the case of divers who have made descents and have been unable to equalize the pressure on the membrane. It is believed that the attendant pain, which is severe in character, is a safeguard in this condition as it gives ample warning.
>
> A study of the auditory acuity and its decline among divers would be significant if it appeared that this decline was more rapid and more notable than the average in a similar age group not engaged in diving.

The well known subjective sensations in the ears which workers in an atmosphere of compressed air experience have been described by many observers.

In 1898, Lester and Gomez,[7] while in a caisson, found that bone conduction was affected to a greater degree than air conduction, and that the hearing power for air and bone conduction was reduced directly in proportion to the air pressure in the caisson.

---

5. Boot, G. W.: Caisson Workers' Deafness, Ann. Otol. Rhin. & Laryng. **22**:1121 (Dec.) 1913.

6. Damant, G. C. G.: Notes on the Laurentic Salvage Operation and the Prevention of Compressed Air Illnesses, J. Hyg. **25**:26 (Feb.) 1926.

7. Lester, J. G., and Gomez, V.: Observations Made in the Caissons of the New East River Bridge, as to the Effect of Compressed Air on the Human Ear, Arch. Otol. **27**:1, 1898.

They were of the opinion that a pressure of 0.5 atmosphere was sufficient to cause retraction of the membrana tympani, and 2 atmospheres caused congestion of the malleolar plexus and in some cases caused displacement of the ossicular chain with resulting tinnitus. As the pressure increased in the air lock, they experienced a slight feeling of fulness in both ears, which was relieved at first by keeping the mouth open. With a further increase of the pressure it seemed as if their ear drum membranes would rupture, and they noticed a high pitched tinnitus but no vertigo. All these symptoms disappeared when they entered the caisson. It was then that the peculiar pitch and intensity of their voices, autophony and difficulty in speaking and the impossibility of whistling were noticed.

Capt. E. J. Grow, M.C., U. S. Navy, Acting Chief of the Bureau of Medicine and Surgery, furnished me with a report from Lieut. Commander G. H. Mankin, M. C., U. S. Navy, to Capt. J. M. Brister, M. C., U. S. Navy, that I have quoted in full.

As is well known, the incidence of damage to the ear drums among the diving personnel of the Navy is much greater than would appear from a study of the vital statistics published in the Surgeon General's annual report. This state of affairs obtains for one of two reasons: the condition is overshadowed by some other incident of diving more serious in nature, or, the ear damage is insufficient to warrant placing the diver on the sick list with the sending of the customary notice to the Bureau of Medicine and Surgery.

Fortunately or otherwise, I am able to cite an incident from recent personal experience. On March 22, 1929, while engaged in submarine escape tests with the "lung" in the 60 ft. mine tank at the Navy Yard, Washington, D. C., it was necessary for Lieutenant Momsen and myself to descend to the bottom of the tank in a diving bell preparatory to escaping to the surface, using the "lung." The diving bell supplied with compressed air was lowered by an electric winch at the surface. By a life line from the bell to the surface we were able to give signals and control the speed with which we were lowered. At about 20 ft. from the surface I began to have slight pain in my right ear. I had had a rather severe head cold for several days but had been able to continue the tests by having a preliminary intranasal treatment designed to shrink the congested mucous membrane, and with this precaution I had had no difficulty in clearing my ears until this particular day. I presume there had been too long a delay between the treatment and the dive. We continued the descent very slowly but by no method could I get air through the eustachian tubes and the pain in both ears became progressively annoying. By signal we asked to have the bell hoisted a few feet. This relieved the pain. On lowering away again the pain reappeared and increased until we reached the 40 ft. level. From 40 ft. on down there was no pain or discomfort, even though the descent was rather rapid. The escape from the diving bell to the surface was made in the routine manner and without discomfort.

After getting out of the water a quantity of bright red blood was blown from the nose. Aside from lowered auditory acuity and the sensation of "talking in a barrel," there was nothing of note in connection with the ears.

I had a somewhat similar experience during the salvage of the U. S. S. S-4 off Provincetown, Mass., in the winter of 1927 when I had to accompany a diver with compressed air illness into the recompression chamber of the U. S. S. Falcon. My left ear did not clear as we increased the pressure in the chamber. I had a

moderate amount of pain, but of course had to continue on account of the condition of our patient. There was subsequent nasal hemorrhage. I thought very little of the incident, and, as I had no one with me at the time who could examine my ear, I never knew what actually occurred.

In the present case I had the ear, nose and throat specialist look at my ears at the time of my next regular appointment for nasal treatment. Much to my surprise, he found both drums ruptured in Shrapnell's membrane and an old scar in the left drum, presumably following the incident on the U. S. S. Falcon. I think one gains from the literature the impression that the pain accompanying the rupture of an ear drum is very severe. From my experience in the two incidents mentioned, I would question this view because at no time was the pain more than quite annoying. It is quite possible that the same lesion produced suddenly would be extremely painful.

Both of my ear drums have healed (one month from the time of their rupture) and there is apparently no diminution in the auditory acuity.

Similar subjective sensations have been described by the divers, Eadie [8] and Ellsburg.[9]

REPORT OF TWO CASES OF TRAUMATIC RUPTURE OF THE TYMPANIC MEMBRANE

Dr. Glenn Adams of Cincinnati referred to me these two cases of traumatic rupture of the tympanic membrane.

CASE 1.—A young colored man, when he left the caisson where he had been working under a pressure of 27 pounds (12.2 Kg.), noticed severe headache, a feeling of fulness and deafness in both ears and bleeding from the nose and the right ear. The following day he was recompressed without relief from these symptoms. The next four days he felt dizzy and experienced severe pains in both ears and the back of the neck. His deafness was unimproved.

When I first saw him a week had elapsed since the accident. He gave a history of having been subject to many attacks of nasal coryza, but he had never noticed any deafness.

The right tympanic membrane showed three distinct recent perforations: a large one directly posterior to the umbo, a smaller one anterior and the third one posterior to the malleus at the level of the umbo. The tympanic membrane was much retracted, with considerable foreshortening of the short process. Anterior to the latter, there was a light reflex. Along the handle of the malleus there was injection, and many fine blood vessels could be seen running down the posterior fold. Shrapnell's membrane was retracted and somewhat congested. There was no drainage of blood or serum from the middle ear. The left tympanic membrane showed no perforations. It did show, however, many blood vessels running down from the anterior and posterior folds and Shrapnell's region, with some congestion of the latter.

The right ear could not hear a whisper, but heard ordinary conversation up to a distance of 2 feet (60.9 cm.). The lower limit was 64 double vibrations and the upper limit was 3.4 with the Galton whistle (normal 0.8). The left ear heard a whisper up to a distance of 2 feet and conversation up to a distance of 14 feet

8. Eadie, Thomas: I Like Diving, Saturday Evening Post, 1928, vol. 201, no. 18.

9. Ellsburg, Edward: On the Bottom, Saturday Evening Post, 1928, vol. 201, nos. 19-22.

(426.7 cm.). The lower limit was 32 double vibrations and the upper limit was 1. The Weber test was referred to the left ear. There was an average loss of hearing in the right ear of 47 per cent and one of 35 per cent in the left ear when tested by the Western Electric 2-A audiometer. The curves of hearing showed a marked depression in 4,096 and 8,192 vibrations.

Nasal examination showed a moderate deviation of the nasal septum with polypoid degeneration of both middle turbinals.

On politzeration, both eustachian tubes were open. For the next two days there was no change in the condition of the patient. A gentle massage of the right tympanic membrane with the Siegel otoscope seemed to improve his hearing slightly, so that he heard a whisper up to a distance of 2 inches (5 cm.) and conversation up to 7 feet (213.4 cm.)

Two days later he was again seen, and at this time the perforations of the membrana tympani were found to be healed. The usual cold caloric test with water at 68 F., with the head 30 degrees forward, produced in the right ear a rotary nystagmus to the left after ninety seconds of irrigation; when the head was put back, the nystagmus became horizontal.

Two weeks after the accident, the right ear heard a whisper 1 foot (30.5 cm.) away and ordinary conversation 12 feet (365.8 cm.) away. The left ear heard

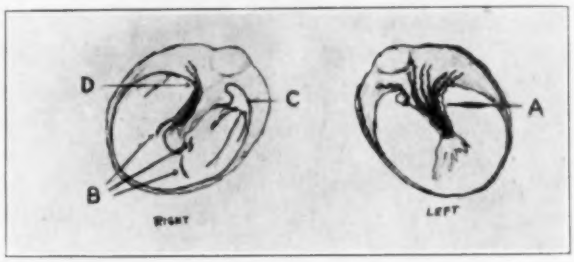


Fig. 1 (case 1).—Diagrammatic sketch of the tympanic membranes. The three perforations of the right tympanic membrane are indicated (*B*) as well as the extent of injection of both membranes (*A*). *C* indicates light reflex.

a whisper at a distance of 14 feet. The hyperemic reaction in the tympanic membrane had disappeared. The man still felt a little dizzy and noticed pain and tinnitus in both ears.

One month afterward, he was able to hear a whisper 3 feet (91.4 cm.) away and conversation at 14 feet. After six weeks, he heard a whisper at 5 feet (152.4 cm.) and the 32 double vibration fork, and by two and one half months the right ear heard a whisper at 6 feet (182.9 cm.) and conversation at 14 feet. The Weber test was referred to the left ear.

CASE 2.—A young man was working in the same caisson under 30 pounds (13.6 Kg.) of pressure. While in the caisson he noticed a buzzing noise in the ears and dizziness, but was able to work for his two hour shift. During the afternoon shift he felt dizzy and sick, and both ears felt stopped up. One hour after leaving the caisson, he noticed some bleeding from the right ear, with severe headache and deafness in that ear. By nightfall the headache had become very severe. I saw him the following day, and in the right tympanic membrane were two perforations with fresh blood draining through them. The largest perforation, which was rather ragged, was situated below the umbo. The other perforation was in the posterior superior quadrant just below the posterior fold.

Shrapnell's membrane was markedly retracted and congested. The tympanic membrane was retracted and was bluish. Dried blood clots could be seen in the external auditory canal. The left tympanic membrane was intact, markedly retracted, and many blood vessels could be seen running from the posterior fold downward along the handles of the malleus.

Comment.—Both ears heard a whisper 14 feet away. The lower limit in the right ear was 48 double vibrations, and in the left 32 double vibrations. The Weber

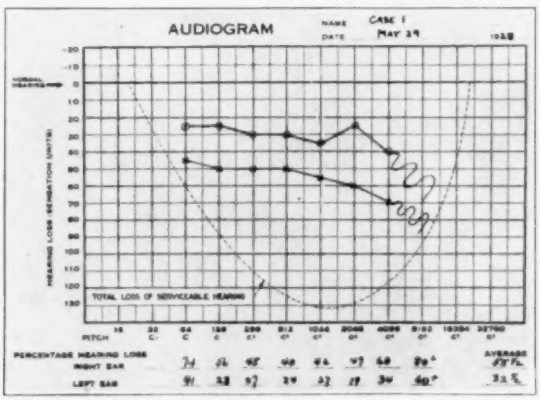


Fig. 2 (case 1).—Audiogram one week after the accident.

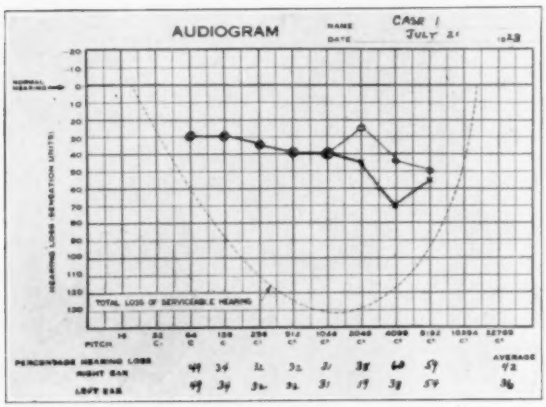


Fig. 3 (case 1).—Audiogram two months after the accident.

test was not referred. The audiometer showed a loss of hearing in the right ear of 18 per cent and one of 10 per cent in the left ear. Most of the loss of hearing was in the lower range.

The second patient was not affected as severely as the first, yet the tympanic membranes in both ears were much alike. The first man had vertigo and marked deafness of the so-called internal ear type, while the second showed no serious disturbances.

COMMENT

The ear may be affected in two ways by the direct action of compressed air. 1. There may be a more or less mild form of trauma when

the damage is confined to the middle ear. 2. There may be trauma when, besides damage to the middle ear, injury is done to the internal ear.

Alexander [10] thought that the inner ear symptoms appearing in caisson workers were caused by hyperemia and small hemorrhages in the internal ear, and that the symptoms might appear acutely after the injury or could at times have a chronic progressive course.

Boot was of the opinion that tubal tympanic catarrh caused exaggerated symptoms in those working in an atmosphere of compressed air; that when the patient showed symptoms referable only to the vestibular apparatus, recovery was complete, and that the most characteristic result when the ears were injured was a loss of a considerable portion of the upper range of hearing with marked lessening of bone conduction. In some cases the organ of Corti seemed to have been suddenly destroyed.

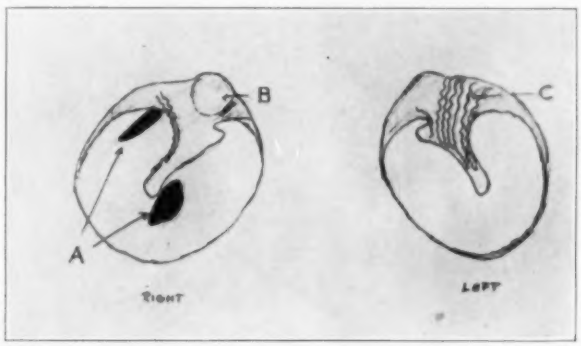


Fig. 4 (case 2).—A sketch of the tympanic membranes, which shows the location and extent of the perforations (bleeding) of the right tympanic membrane (*A*) and the marked vascular injection in both drum membranes (*C*). *B* indicates marked retraction.

Furthermore, Boot believed that the vestibular portion of the labyrinth was more resistant than the cochlear portion.

Bert [11] expressed the opinion that all accidents from the most trivial to those which caused sudden death in caisson workers, were the consequences of the disengaging of bubbles of nitrogen from the blood and tissues when compression has lasted a sufficient time.

Though this is true of caisson disease, it is not the entire cause when the ear is concerned. There are two main types of ear trauma: one in which the symptoms are a part of the symptom-complex of caisson disease and produced by nitrogen bubbles in the cochlear and vestibular

10. Alexander, G.: Die nichteitrigen Erkankungen des inneren Ohres, in Denker and Kahler: Handbuch der Hals-, Nasen- u. Ohrenheilkunde, Berlin, Springer & Bergmann, 1926, vol. 7, p. 553.

11. Bert, P., quoted by Hill (footnote 1).

apparatus, and the other in which they are due directly to the action of the compressed air.

Many authors have felt that the aural trauma during compression was due to the nonequalization of pressure on the two sides of the tympanic membrane. All observers have stated that it was necessary for the caisson workers or divers to swallow or to perform the Valsalva test in order to relieve the painful subjective symptoms experienced in the ears.

Hill believed that the hemorrhages so frequently noted in naked divers were due to a cupping effect in the nasal and ear cavities. If the eustachian tube was open, the pressure would be equalized and no cupping effect could take place in the middle ear. He stated that the diminution of volume of the air in the nasal and aural cavities was

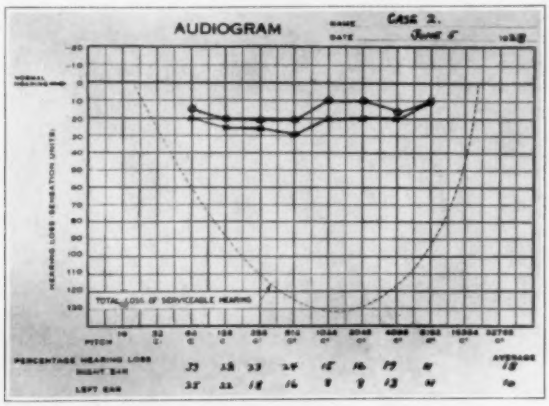


Fig. 5 (case 2).—Audiogram the day following the accident.

greatest in the change from 1 to 2 atmospheres, and that this was the point of greatest danger to the ears. Afterward, at higher pressures, there was little trouble, as the volume of the air in the nasal and aural cavities diminished with proportionate slowness, and enough air passed through the eustachian tube when it had once been well opened.

Von Schrötter stated that on decompression of caisson workers, crackling noises due to the escape of air through the moist eustachian tubes could be heard.

Alt believed that if the eustachian tube was closed there was a negative pressure in the middle ear cavity with a forcing in of the tympanic membrane. The blood vessels enlarged, and a condition resulted that he called "Stauungshyperaemia" of the middle ear and the labyrinth, which could persist beyond the actual time of exposure to the compressed air. He quoted the manometric studies of Politzer and Bezold, who

showed that an increase in the pressure of the middle ear caused an increase in the labyrinthine pressure, while a decrease of the amount of air in the middle ear, caused a fall in the labyrinthine pressure.

EXPERIMENTAL DATA

Hill reported his experiments and those of Lord Haldane, Boycott, Damant and von Schrötter, to prove that not only were the symptoms of caisson illness due to the formation and circulation of nitrogen gas

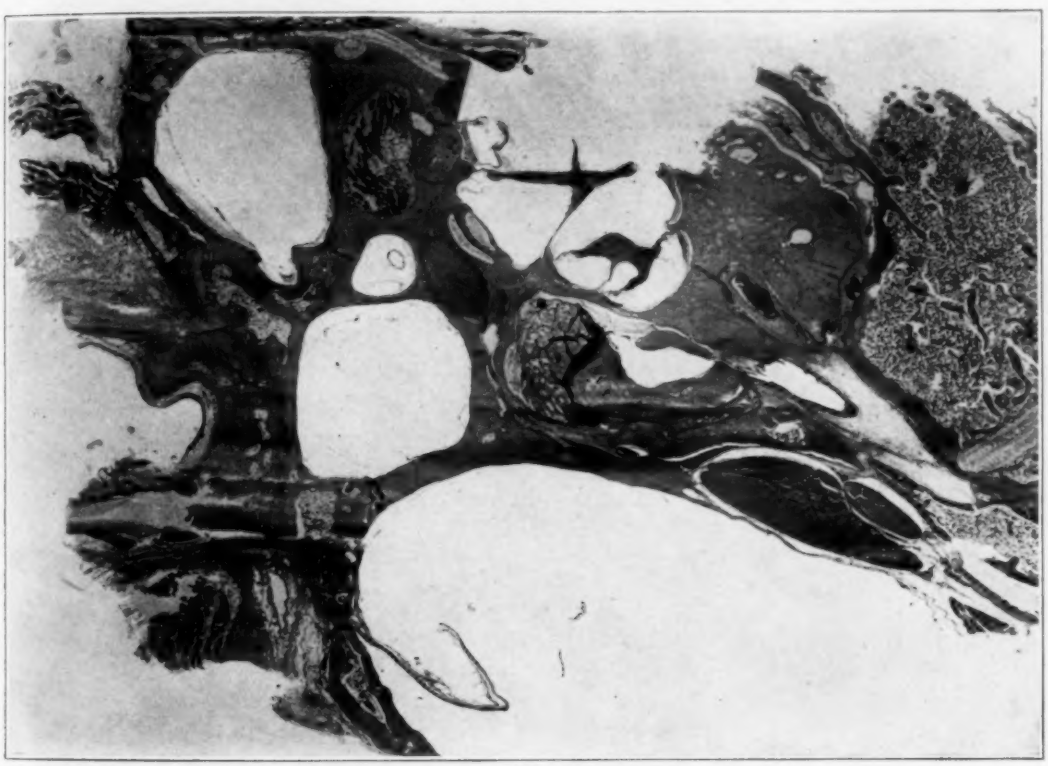


Fig. 6.—Section showing the middle and internal ear of a control rabbit.

bubbles in the tissues of the body, but that the bubbles occurred most frequently in those parts of the body in which the circulation of the blood was the poorest.

Von Schrötter was able experimentally to produce bubbles of nitrogen in the semicircular canals of animals.

Alt observed ecchymosis of both tympanic membranes and two typical cases of bleeding in the middle ears of dogs subjected to a pressure of 5 atmospheres. Examination of the specimens by Professor Gruber showed the mucosa of the tympanic membranes to be intensely

congested with many dilated blood vessels, with similar changes in the middle ear and, in addition, serosanguineous extravasation in the latter.

Microscopic study of the sections of the ears of rabbits subjected to a pressure of 2.5 atmospheres for twenty minutes with rapid decompression and death after four days showed slight engorgement of the blood vessels and perivascular extravasations. The nerve fibers were unchanged.

My experiments were done to simulate actual working conditions as nearly as possible. The animals were subjected to a rapid rise of

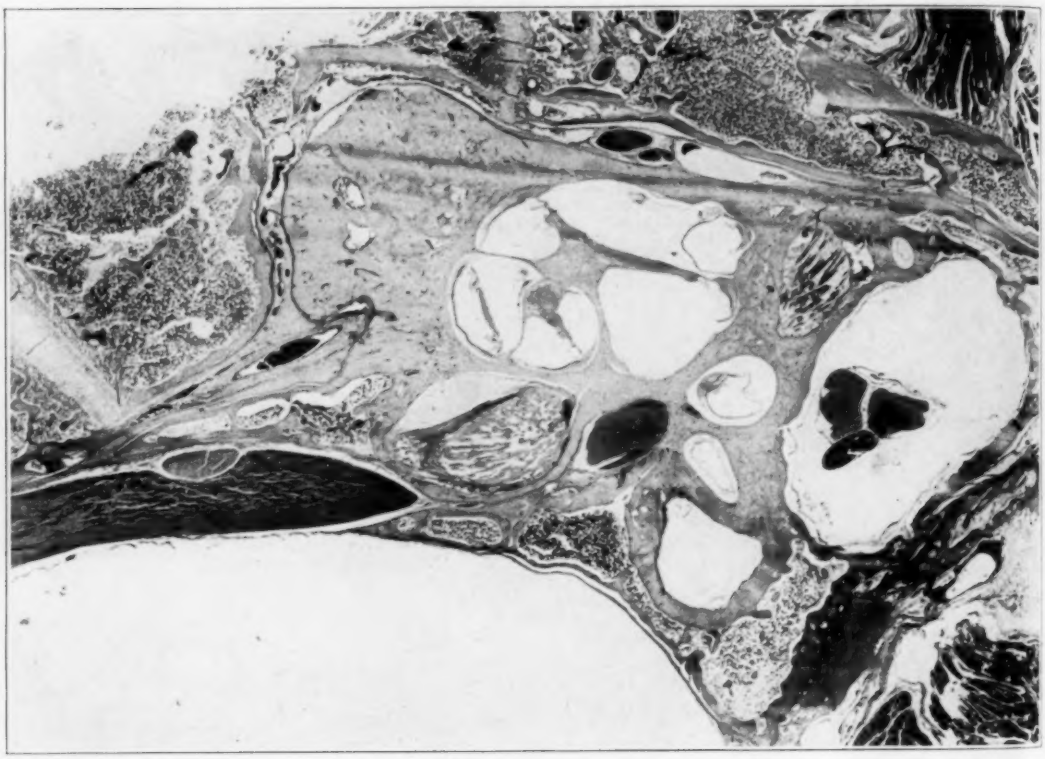


Fig. 7.—Section of the temporal bone of the rabbit in experiment 1. Note the hemorrhage and dilated blood vessel along the malleus and incus. The internal ear showed no hemorrhage.

pressure followed in a few minutes by a gradual reduction of pressure by stages, in order to obtain, if possible, the results of the direct action of the increasing air pressure on the ears. Furthermore, one eustachian tube of each dog was obstructed by a piece of bougie. With the dog under ether anesthesia, the soft palate near its attachment to the hard palate was incised for about 1½ inches (3.77 cm.), and after the edges were retracted to expose the nasopharyngeal orifice of the eustachian

tubes, with a curved hemostat, a quarter inch (0.63 cm.) piece of hard rubber or whalebone bougie was inserted and buried out of sight.

EXPERIMENT 1.—A young white rabbit, weighing 450 Gm., was placed in a compression tank, and by one-half minute a pressure of 70 pounds (31.8 Kg.) was obtained which was continued for one minute. Three minutes later the pressure was reduced to 30 pounds, one and one-half minutes later to 10 pounds (4.5 Kg.) and in another minute and a half to zero. An hour later, the temporal bones were removed and fixed.

At the same time a control rabbit of the same weight and age was killed and its temporal bones fixed.

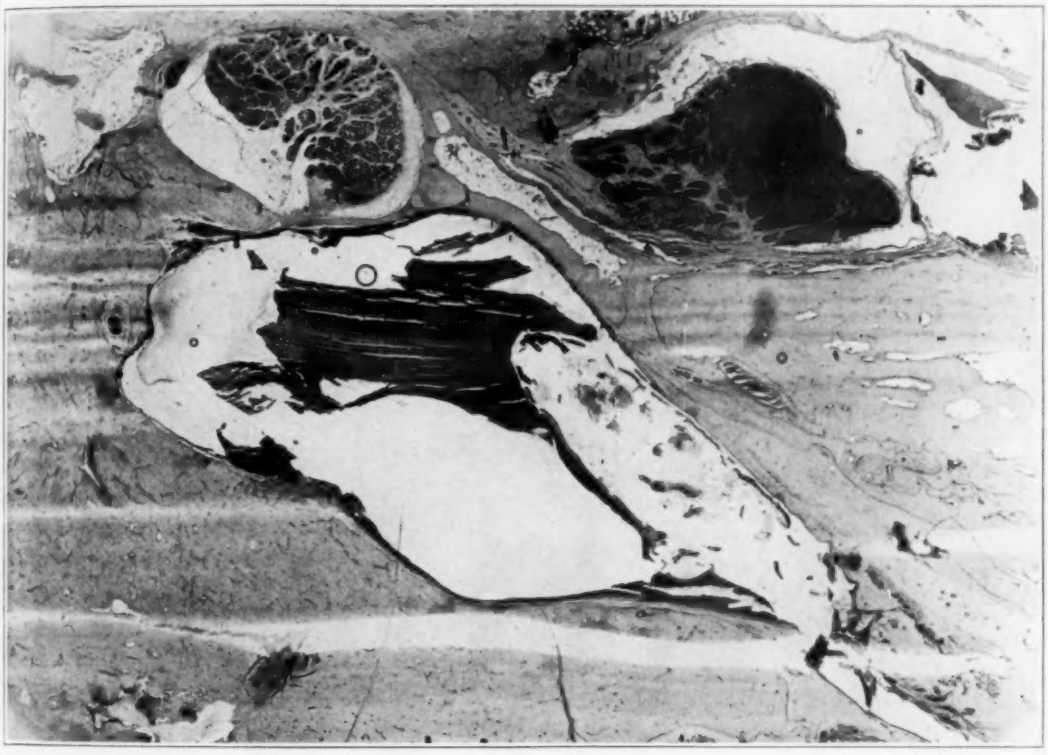


Fig. 8.—Section of the middle ear of dog 1, showing the site of the bougie in the eustachian tube as well as the hemorrhage occurring in the middle ear.

EXPERIMENT 2.—Two young white rabbits, weighing about 450 Gm., were used. Modeling wax was tightly pressed into one external canal of each rabbit, and these rabbits placed in a compression tank. By one minute a pressure of 75 pounds (34 Kg.) was obtained; this was continued for one minute, and then reduced to 40 pounds (18.1 Kg.) in twenty-five seconds. The pressure of 40 pounds was maintained for two minutes, and all the remaining compressed air escaped in forty seconds more. In one rabbit, gross examination of the ears after decalcification showed no macroscopic blood in the middle ears, and in the other rabbit it showed where the wax had been placed, an extravasation of blood into the middle ear cavity but without rupture of the drum membrane.

EXPERIMENT 3.—The right eustachian tube of a dog was obstructed by a piece of bougie, and the dog placed in the tank. The pressure was raised to 75 pounds in one minute, kept there for another minute and then reduced to 40 pounds in twenty-five seconds. It was held at 40 pounds for two minutes, then reduced to 15 pounds (6.8 Kg.) in twenty seconds and held there for two more minutes, and in forty seconds the air was all out. Gross examination after decalcification showed a rupture of the right tympanic membrane and hemorrhages filling both middle ears and mastoid cells.

Fig. 9.—Section of the middle ear of dog 2, showing the extent of hemorrhage and the lifting up of the mucous membrane of the middle ear cavity by a hemorrhage.

EXPERIMENT 4.—A one-half inch (1.27 cm.) piece of a flexible bougie was inserted into the left eustachian tube of a dog. Thirteen days later the animal was placed in a compression tank, and the pressure raised to 80 pounds (36.3 Kg.) in one and one-half minutes. This pressure was maintained for one and one-half minutes, reduced to 40 pounds in three minutes and to 12 pounds in one and one-fourth minutes, and all the air was out in another one-half minute. One hour later the dog was killed by ether. Otoscopic examination showed no perforations of the tympanic membranes. Both drum membranes were retracted; the left showed considerable injection along the malleus.

EXPERIMENT 5.—A dog that had had the bougie inserted in the right eustachian tube thirteen days previously was placed in the compression tank, and in one minute and fifteen seconds the pressure was raised to 80 pounds and maintained at that level for one-half minute. It was then reduced to 40 pounds in forty seconds, held there for two minutes and then reduced to 20 pounds in ten seconds. Otoscopic examination showed both drum membranes quite bluish and retracted, without gross perforations.

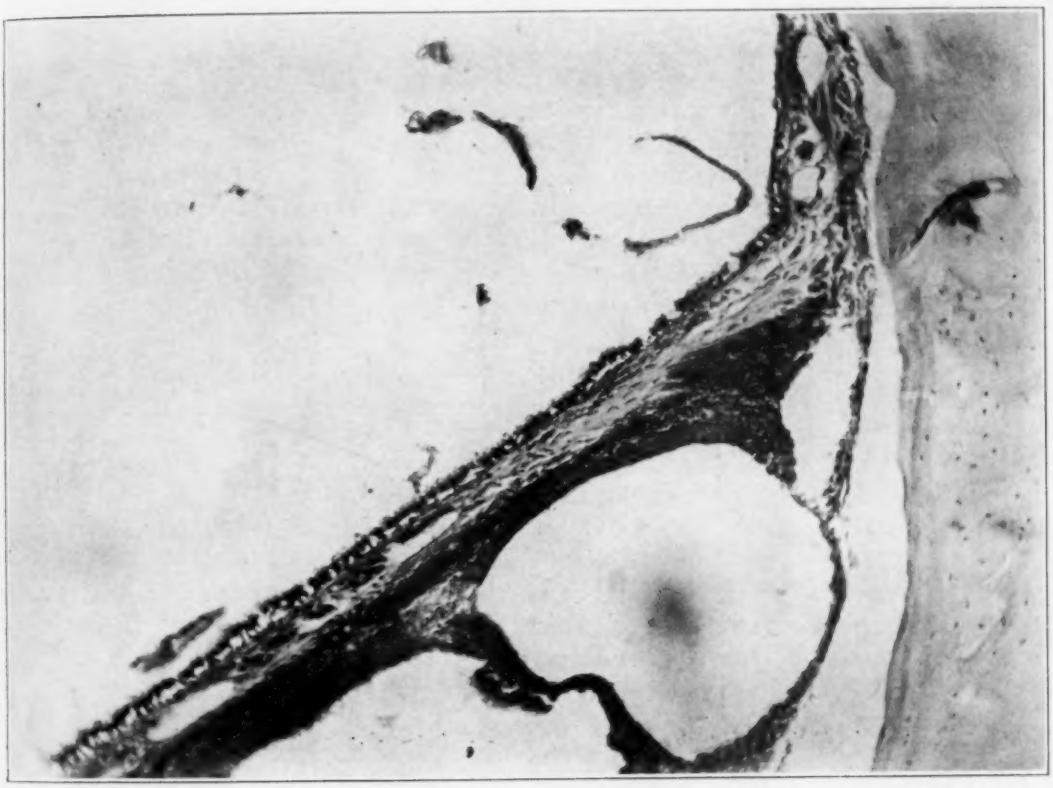


Fig. 10.—A higher magnification of the section shown in figure 9, showing the mechanism of the elevation of the middle ear mucosa by the submucosal bleeding.

REPORT OF THE MICROSCOPIC STUDY OF THE SPECIMENS BY DR. N. C. FOOT

In every case the lesion was essentially the same, so that the three specimens may be considered together. The constant lesion was a copious hemorrhage into the cavity of the middle ear, apparently originating in small vessels in the submucosa. That this was so was indicated by the fact that the mucosa was lifted off its bony bed and carried well into the center of the cavity, coming to lie on a copious blood clot which was evident, even on gross examination, in every ear examined in this series. In one instance, it was found that this hemorrhage penetrated into the vestibule of the ear, where it filled the cavity almost entirely.

In another section the tip of the bougie introduced through the eustachian canal was seen in situ and the canal is shown in longitudinal section. There was scarcely any difference between sections from the ears that were plugged with eustachian bougies and those not thus occluded; in each instance there had been copious bleeding into the cavity of the middle ear and that of its vestibule.

It may be noted that the structures of the internal ear, the mastoid cells and the bone-marrow of the temporal bone were little altered from their normal appearance; if there were lesions of these anatomic units, they were not evident.

The tympanic membrane was not necessarily ruptured in the dogs. One dog had a marginal perforation on the side where the eustachian tube had been closed.

SUMMARY

Trauma can be inflicted on the middle and internal ears in workers in an atmosphere of compressed air, not only during compression, but also during or after decompression. In the first group the symptoms may be temporary or permanent. In the second group they are usually permanent. Though the cochlear and vestibular portion of the internal ear are both affected, the case reports would seem to show that the cochlear portion of the labyrinth is slower to recover than the vestibular portion.

In the first group, the aural trauma is caused by nonequalization of pressure within and without the middle ear and transmitted to the internal ear with resulting stasis and hemorrhages.

In the second group, the aural lesions are due to bubbles of nitrogen forming emboli or areas of necrosis in the internal ear.

CONCLUSIONS

1. The two cases reported and some experimental observations by the author conform with the clinical observations hitherto recorded concerning aural trauma in workers under compressed air, and suggest the advisability of a careful examination of the nasal sinuses as well as of the ears in the workers.

2. Workers who have suffered traumatic rupture of the tympanic membranes should undergo recompression only in the event that symptoms of caisson illness appear. It would seem advisable that an otologist should be in attendance in such cases.

3. A wide and careful survey must be made to decide whether the percentage of deafness is uniformly high in persons working under compressed air.

I am greatly indebted to Dr. N. C. Foot, professor of pathology at the College of Medicine, University of Cincinnati, for the preparation and study of the microscopic sections, to Dr. W. D. Andrus and Dr. J. L. Donnelly of the Laboratory of Experimental Surgery, Cincinnati General Hospital, for their advice and cooperation and to Mr. James J. Taylor of the Stacey Brothers Gas Construction Company of Elmwood, Cincinnati, through whose assistance the compression experiments were made possible.

PATHOLOGIC CHANGES IN TONSILS

A STUDY OF TEN THOUSAND PAIRS OF TONSILS, WITH SPECIAL REFERENCE TO THE PRESENCE OF CARTILAGE, BONE, TUBERCULOSIS AND BODIES SUGGESTIVE OF ACTINOMYCOSIS *

H. FIELDING WILKINSON, M.D.
Fellow in Otolaryngology, The Mayo Foundation
ROCHESTER, MINN.

During the last three decades, and especially in the last ten years, much has been written regarding the pathologic changes in the faucial tonsils. The early reports were of individual cases which demonstrated features that seemed to be unusual. Gradually, larger groups were studied, until within the last five years a number of articles have been published covering the systematic examination of the pathologic changes in several thousand cases. Throughout these years, various features have been mentioned: tumors, abscesses, the presence of foreign bodies, giant cells, cholesterol, foreign substances, concretions and cysts. However, three pathologic changes in the tonsils have received particular attention. In the order of their interest these have been cartilage and bone, tuberculosis and bodies resembling those seen in actinomycosis. All investigators agree that these three groups are definite. Yet, a wide divergence of opinion exists as to the percentage frequency of each and opinions differ as to the origin of cartilage and bone as they occur in the tonsils.

The first cases in which cartilage and bone were found were reported in 1893. At that time, Orth [1] drew attention to two cases which he had observed, one with bone and the other with both bone and cartilage in the capsule of the tonsil. These disclosures stimulated interest because of their unusualness and controversy because of the proffered theory that the origin of this cartilage and bone was in branchial rests. Shortly afterward, Deichert [2] reported five cases and expressed the opinion that the presence of the bone and cartilage was due to embryonic aberrations. Following this report further cases and different explanations were offered.

---

* Submitted for publication, May 11, 1929.

* Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Otolaryngology, 1928.

1. Orth, Johannes: Arbeiten aus dem pathologischen Institut in Göttingen, Berlin, A. Hirschwald, 1893, p. 60.

2. Deichert, H.: Ueber Knorpel-und Knochenbildung in den Tonsillen, Arch. f. path. Anat. **141**:435, 1895.

Walsham [3] advanced the theory that the cartilage and bone were developed from the connective tissue by a process of metaplasia. Shortly after this, Nösske [4] took a stand midway by stating that metaplasia was a factor but that also there existed an inherent quality in the tissues which predisposed them to change into cartilage and bone under the influence of an inciting factor. This factor, he thought, was inflammation.

Concerning the percentage frequency of occurrence of cartilage and bone, Tramontano-Guerritore [5] found that both occurred in as high as 46 per cent of all tonsils; Moore [6] thought that more than one third of all tonsils had some cartilage in them, whereas Forman [7] was able to discover but one case with cartilage in 350 examined. Other observers, among them Reitmann,[8] Portmann and Spalaïkovitch,[9] Hambrecht and Nuzum,[10] found the percentage of occurrence anywhere between these extremes.

Tuberculosis has attracted nearly as much attention. Considerable discrepancy again prevails in the percentage occurrence in which tuberculosis has been found. Forman was able to find but 0.5 per cent of tonsils with evidence of tuberculosis, whereas Robertson [11] reported 8 per cent positive. Weller,[12] who examined 8,697 tonsils, came to the conclusion that tuberculosis could be demonstrated in 2.35 per cent. This is a large series and the study was carefully done.

Actinomycosis, less positively called actinomycoid granules of the tonsillar crypts, has been the subject of many investigations. The percentage incidence and the nature of the fungoid masses vary in the

---

3. Walsham, Hugh: Occurrence of Cartilaginous and Bony Nodules in the Tonsil, Lancet **2**:394, 1898.

4. Nösske, Hans: Ueber Knorpel-und Knochenbildung in den Tonsillen, Deutsche Ztschr. f. Chir. **66**:559, 1902.

5. Tramontano-Guerritore, G.: A proposito di formazioni ossee e cartilginee nella tonsilla palatina umana, Sperimentale **77**:465, 1923.

6. Moore, I.: Osseous and Cartilaginous Formations in the Tonsils, J. Laryngol. & Otol. **39**:117 and 195, 1924.

7. Forman, Jonathan: The Occurrence of Nodules of Cartilage in the Tonsil, Ann. Otol. Rhin. & Laryng. **27**:137, 1918.

8. Reitmann, Karl: Ueber das Vorkommen von Knorpel und Knochen in den Gaumentonsillen, Monatschr. f. Ohrenh. **37**:321, 1903.

9. Portmann, G., and Spalaïkovitch, R.: Contribution à l'étude du tissu cartilagineaux amygdalien, Rev. de laryngol. **44**:543,- 1923.

10. Hambrecht, Leonora, and Nuzum, F. R.: A Correlated Study of the Indications for Tonsillectomy and of the Pathology and Bacteriology of the Excised Tonsils, Arch. Int. Med. **29**:635 (May) 1922.

11. Robertson, C. M.: Certain Facts Concerning Faucial Tonsils, J. A. M. A. **47**:1725 (Nov. 24) 1906.

12. Weller, C. V.: The Incidence and Histopathology of Tuberculosis of the Tonsils, Arch. Int. Med. **27**:631 (June) 1921.

reports of almost all investigators. Wright [13] found one case in seventy-five examined. D. J. Davis [14] claimed that at least 30 per cent of extirpated tonsils contain actinomycotic-like bodies in the crypts. All observers agree that whatever the nature of the granules may be, they are not pathogenic.

It will be noted, then, that the percentage frequency in each group varies widely. This does not necessarily imply incorrect observations or interpretations. In the beginning, few cases were studied. Methods and terminology differed. The material used was from widely different races, ages, social strata, environment and groups. These variables make it possible for many apparently contradictory results to be correct.

With these possible sources of error in mind and in view of the prevalent opinion as to the origin of cartilage and bone, a group of 10,000 pairs of tonsils was systematically examined, with the intention through examination of a large number to eliminate many of these factors of error, or at least to minimize them. No claims are made for the conclusions of this study, in relation to percentage, other than that, owing to the large number of tonsils, the effect of errors on the results is diminished and that the data represent the minimal percentage of the types of pathologic processes studied for the section of the country in which the study was made and for the type of practice from which the material was derived. Further, it is hoped that beyond bringing attention to a hitherto unmentioned observation in the excised tonsil, some new light will be shed on one of the possible origins of cartilage and bone in the tonsil.

MATERIAL STUDIED

In order to obtain the desired number of 10,000 cases, all the tonsils removed at the Mayo Clinic in the years 1923, 1924, 1925, 1926 and in the first few weeks in 1927 were taken. No tonsils were discarded. In a few instances only one tonsil was available and in a slightly larger number only tonsillar tags were obtainable. These, however, presented sufficient material to warrant their being included. In this large number of cases and in view of the method used, the presence of only one tonsil or of tonsillar tags would have a negligible effect on the general results. There arises, therefore, no question of error from selection except as the group represents cases occurring only in the last four and a fraction years. Of the total number, by far the greater proportion were removed because they were believed to constitute foci of infection. The remainder were removed because

13. Wright, Jonathan: Actinomycosis of the Tonsil, Am. J. M. Sc. **128**:74, 1904.

14. Davis, D. J.: A Comparative Study of the Crypt Content of Tonsils of Man, Pig, and Cow, J. A. M. A. **81**:1172 (Oct. 6) 1923.

of local indications. Thus, tonsillitis and peritonsillar abscess, which would affect the tissue locally and the resultant pathologic picture, are largely ruled out. Although the patients came from all walks of life, the largest group was made up of farmers. There were none of the so-called institutional cases. This eliminates a factor which would especially affect the percentage of tuberculosis.

METHOD OF STUDY

Immediately after being removed, the tonsils were placed in a 10 per cent solution of formaldehyde. After fixation each tonsil was bisected horizontally as near to the center as possible and at right angles to the oropharyngeal surface.

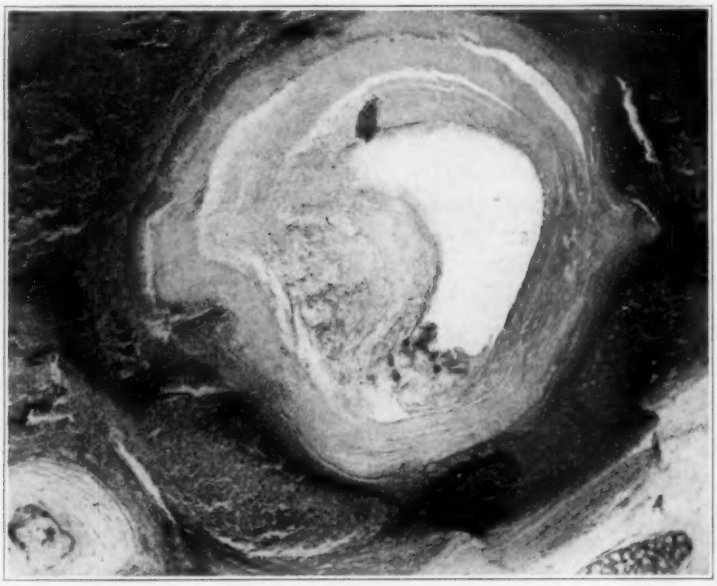


Fig. 1.—Section of tonsil, showing hyperkeratosis 3; fibrosis 1; pus 1, and ulceration 1 (× 30).

From the bisected surface of each tonsil a frozen section was made, and after it was mounted it was stained with hematoxylin and eosin. During the process of sectioning, care was taken to note the presence of any material, such as tonsilloliths, which would resist the knife. Any pathologic features were noted. In order to make a permanent quantitative record of these data which would be variable, such as the amount of fibrosis, pus, ulceration, cartilage and bone, an arbitrary scale was selected on a basis of 1 : 4. Both slides, one from each tonsil, were then examined, and a general average of the condition in the two was calculated. In this way, the report was made on a basis of cases and not on the basis of the individual tonsil. Keratosis of the crypts, which is a physiologic process, was simply noted and was graded only when marked (fig. 1). The degree of fibrosis depended on the relative thickening of the capsule, trabeculae and perivascular

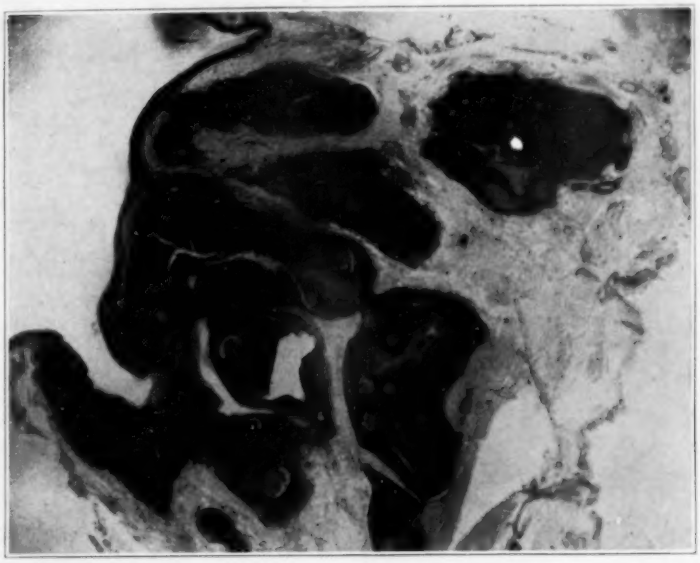


Fig. 2.—Section of tonsil, showing fibrosis 2; pus 2; ulceration 1, and bone 1 (× 12).

Fig. 3.—Section of tonsil, showing pus without ulceration; fibrosis 2; pus 2, and ulceration 2 (× 60).

spaces. By this method, which was devised by Broders,[15] a relatively small amount of fibrosis was designated as grade 1; if the general average of fibrosis was somewhat more marked, it was graded 2 (fig. 2); if still more marked, and closely approaching the lymphoid elements in amount, it was graded 3; when the amount of fibrosis exceeded that of the lymphoid elements, it was graded 4. This same method of measurement was carried out in making the permanent record of the amount of pus and ulceration that was found. Frequently, many of the crypts contained little or no pus, whereas others contained a large amount. In the latter, some crypts gave evidence of much ulceration whereas others did not show any ulceration. Frequently, pus was found without ulceration (fig. 3), and vice versa (fig. 4). A general average was estimated and a record made on that basis. Cartilage and bone were recorded in a similar way, the

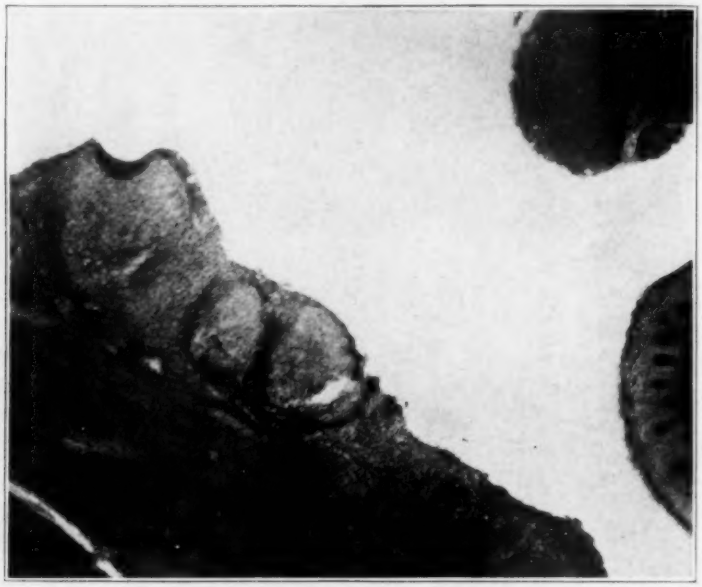


Fig. 4.—Section of tonsil, showing ulceration without pus; fibrosis 2; pus 2, and ulceration 3 (× 30).

grade indicating both the amount of each in relation to the section itself and the amount of each in relation to the amount found in the other sections (figs. 5, 6 and 7).

At first, such a method would seem to entail a large error owing to individual variation in estimating the relative amounts of the various substances sought. It was found, however, that after very little training a careful observer would, in a series of several hundred slides, make approximately the same gradations. Even granting an error due to individual interpretation and a somewhat loose method, as the entire 10,000 tonsils were examined by the same person, the same percentage

15. Broders, A. C.: Personal communication to the author.

Fig. 5.—Section of tonsil, showing cartilage 3; fibrosis 1; pus 2, and ulceration 1 (× 75).

Fig. 6.—Section of tonsil, showing cartilage 3; bone 2; fibrosis 2; pus 1, and ulceration 1 (× 75).

of variation would enter into all cases. This makes what apparently seems an elastic method an accurate one. Any error, therefore, that would arise from interpretation of gradations would be negligible.

The examination was made without any previous knowledge either of the patient's complaint or of the indications for tonsillectomy. This removed an element which often influences interpretation of the abnormalities found. The relatively small number of sections examined from each tonsil must give rise to error. For that reason the percentages herein stated can be accepted only as minimal percentages for this group and when the method described is used. It is possible that longitudinal sectioning might alter the percentages, especially in the

Fig. 7.—Section of tonsil, showing cartilage 2; bone 3; pus 2, and fibrosis 2 (× 30).

cases in which cartilage and bone occurred, as by the horizontal method anything that might occur exclusively at the upper or the lower pole is missed. If, as Weller [16] stated, there is a type of cartilage which occurs at the lower pole, the method used would have missed disclosing it; in that event the percentage in which bone and cartilage were found in this group would be less than the true percentage incidence of these elements. In a longitudinal bisection, however, any cartilage or bone in the anterior or posterior portions would be missed. The only method not open to criticism would be serial sectioning. Such a procedure,

16. Weller, C. V.: The Incidence and Histopathology of Bone and Cartilage in the Tonsils, Ann. Otol. Rhin. & Laryng. **32**:687, 1923-1924.

although most desirable, would be out of the question in the examination of any considerable number of cases.

In order to obtain a graphic picture of the frequency of occurrence of the various grades within each pathologic group, as well as a comparison of the group as a whole with the various divisions, the biometric method of Raymond Pearl was selected. This method gives the true average, or mean, of the material, which, although not the same as the arithmetic average, usually is close to it. The standard deviation is the degree of scatter or dispersion of the variates which make up the

TABLE 1.—*Percentage Frequency Distribution According to Age Groups in the Entire Series of 10,000 in Which Tonsillectomy was Done and in a Subsidiary Group*

Age, Years	10,000 Pairs of Tonsils			1,088 Pairs of Tonsils *			Difference	Probable Error of Difference	Difference ÷ Probable Error	Significance of the Difference
	Frequency	Per Cent	Probable Error, Per Cent	Frequency	Per Cent	Probable Error, Per Cent				
0– 4.....	271	2.71	0.10	8	0.73	0.17	1.98	0.197	10.50	65,000,000 to 1
5– 9.....	601	6.01	0.16	10	0.91	0.20	5.10	0.258	19.75	65,000,000 to 1
10–14.....	275	2.75	0.11	2	0.18	0.09	2.57	0.142	18.11	65,000,000 to 1
15–19.....	567	5.67	0.16	30	2.75	0.34	2.92	0.376	7.76	427,000 to 1
20–24.....	1,084	10.84	0.20	70	6.43	0.50	4.41	0.538	8.20	14,700,000 to 1
25–29.....	1,185	11.86	0.21	108	9.92	0.61	1.94	0.645	3.01	22.24 to 1
30–34.....	1,363	13.63	0.23	140	12.86	0.65	0.77	0.689	1.12	1.18 to 1
35–39.....	1,250	12.50	0.22	163	14.98	0.73	2.48	0.763	3.25	37.42 to 1
40–44.....	1,087	10.87	0.21	170	15.62	0.74	4.75	0.770	6.17	19,300 to 1
45–49.....	905	9.05	0.19	134	12.31	0.66	3.26	0.687	4.74	655.3 to 1
50–54.....	672	6.72	0.17	116	10.66	0.63	3.94	0.652	6.04	19,300 to 1
55–59.....	450	4.50	0.14	71	6.52	0.51	2.02	0.530	3.81	95.38 to 1
60–64.....	210	2.10	0.10	46	4.22	0.41	2.12	0.422	5.02	1,341 to 1
65–69.....	66	0.66	0.05	14	1.28	0.23	0.62	0.235	2.64	11.58 to 1
70–74.....	9	0.09	0.02	4	0.36	0.12	0.27	0.122	2.22	6.25 to 1
75–79.....	4	0.04	0.01	2	0.18	0.09	0.14	0.087	1.61	2.57 to 1
Total	10,000	.....	....	1,088	.....	....	6.74	0.316	21.33	65,000,000 to 1
Mean			33.56				Mean		40.30	
Standard deviation.....			17.70				Standard deviation.....		12.65	
Probable error.....			0.10				Probable error.....		0.30	

* Cartilage or bone, or both, were found.

mean. The probable error is based solely on the standard deviation and the number of cases. It shows the reliability of the spread which goes to make up the mean.

INCIDENCE

Sex Incidence.—Of the 10,000 cases, 4,616 were in females and 5,884 in males. This small difference demonstrates the advisability of taking a large number of cases into consideration. The youngest patient was a female, the oldest, a male.

Age Incidence.—The true average or mean age in the 10,000 patients was 33.56 years. The standard deviation, or the spread of the material was 17.7 years, with a probable error of 0.1 year (table 1).

The youngest patient was 7 months, the oldest, 79 years. By far the largest number of patients fell within the ages of approximately 16 and 51, as indicated by the standard deviation, the number diminishing at both ends of the life scale. Considering, however, that the material was obtained at operation and not post mortem, the extremes of life are well represented. With 271 patients within the first five years and 289 in the seventh and eighth decades, a fair estimate of the incidence can be obtained.

PATHOLOGIC CHANGE

After a complete compilation of the data in the 10,000 cases, it was found that in 8,573 cases there was nothing of unusual interest. The

TABLE 2.—*Frequency Distribution According to Pathologic Conditions Which Were Found in 10,000 Pairs of Tonsils*

Fibrosis, pus and ulceration without other observations.	8,573
Cartilage and bone	1,121
Fungus	177
Cholesterin	65
Tuberculosis	52
Foreign-body giant cells	29
Stones in crypts	10
Foreign substance	8
Trichinas	6
Peritonsillitis	5
Abscesses	4
Cyst	2
Calcareous degeneration	2
Squamous cell epithelioma	2
Lymphosarcoma	1
Hemangio-endothelioma	1
Marked cryptal hyperplasia	1
Obliterative endarteritis (syphilis?)	1
Ulceration of the surface of one tonsil	1
Pigmentation of the crypts of one tonsil	1
Blood pigment beneath the epithelium of one tonsil	1
Fibrosis, pus and ulceration without other observations.	85.73
Other observations as above	14.27

only disclosures relative to pathologic changes were various grades of fibrosis, pus and ulceration. The remaining 1,427 cases represent 14.27 per cent of those examined and is that proportion of the tonsils in which were pathologic processes other than those due to the usual inflammation and physiologic change. As there was more or less fibrosis, pus and ulceration in all the tonsils, it might be considered that these are characteristic of the average tonsils. It may be stated, then, that in 14.27 per cent of tonsils there are pathologic processes of a bizarre type. The frequency of distribution of these pathologic processes is given in table 2.

Cartilage and Bone.—In 1,121 of the 10,000 cases there was cartilage alone, bone alone or both cartilage and bone. In thirty-three of these cases (table 3), however, other associated pathologic conditions were found. In order to have an uncomplicated series of cases with cartilage and bone for comparison,

and from which to draw conclusions without qualification, these thirty-three cases were excluded. The remainder, or 1,088, were taken as a group to study. The mean age and the standard deviation in this group, as compared with the entire series, are given in table 1. The spread of the material in the group with cartilage and bone is much less than in the group as a whole. Four hundred and seventy-one (43.2 per cent) were females; 617 (56.89 per cent) were males. The youngest was a girl aged 1 year, the oldest was a man aged 78. There was cartilage alone in 53.30 per cent of the 1,088 cases and bone alone in 4.58 per cent, whereas both cartilage and bone were present in variable amounts in 42 per cent. It will be noted that the appearance of cartilage alone is approximately twelve times as frequent as that of bone alone, but that the occurrence of cartilage and bone together is almost equal to that of cartilage alone. According to Weller,[16] if diligent search is made in cases in which bone is found some cartilage

TABLE 3.—*Frequency Distribution of Associated Conditions in Tonsils in Which Cartilage or Bone or Both Were Found*

Cartilage, bone or cartilage and bone	1,088
Fungus (177) with cartilage and bone	14
Tuberculosis (52) with cartilage and bone	10
Cholesterin (65) with cartilage and bone	4
Stones in crypts (10) with cartilage and bone	2
Foreign-body giant cells (29) with cartilage and bone	2
Foreign substance (8) with cartilage and bone	1
Total	1,121

will always be found associated. If more slides had been made, undoubtedly cartilage would have been found associated with the bone. The frequency and percentage incidence of cartilage and of bone in the various grades from 1 to 4 are given in table 4. Table 5 expresses the comparative relationship between fibrosis, pus and ulceration in the group with cartilage and bone and in the entire 10,000 cases.

It is obvious from table 5 that in cases in which there was cartilage and bone the amount of associated fibrosis and ulceration is definitely increased, whereas that of pus is small. These observations bear out the opinion expressed by other investigators. Lippincott[17] recognized an increase in fibrosis associated with inflammation. Tramontano-Guèrritore[5] expressed the belief that multiple areas of cartilage and bone were the result of inflammatory changes and metaplasia. Carmody[18] thought that the more infection there was present, the more

17. Lippincott, L. S.: Conclusions from the Correlation of Laboratory Findings, Clinical Symptoms, and End Results in Tonsillectomy, New Orleans M. & S. J. **78**:395, 1925-1926.

18. Carmody, T. E.: Histo-Pathology of the Faucial Tonsil, Laryngoscope **24**:587, 1914.

fibrosis there would be. Babbitt [19] noted frequent overgrowth of the fibrous tissue in inflammatory conditions. According to Wood,[20] fibrosis is evidence of former inflammation. He stated further that he found leukocytes in practically all tonsillar crypts. These he thought must be accepted as an indication of infection if leukocytes are significant of disease. On this basis, all tonsils are diseased or pathologic. Hillkowitz [21] reported an apparent increase in fibrous

TABLE 4.—*Frequency and Percentage Distribution, According to Grade of Cartilage and Bone in 1,088 Pairs of Tonsils in Which Cartilage or Bone, or Both, Were Found*

Cartilage	Frequency	Per Cent	Probable Error
Grade 1	839	80.90	1.88
Grade 2	177	17.06	0.79
Grade 3	21	2.02	0.30
Grade 4	...	.....	....
Total	1,037		
Bone			
Grade 1	449	88.38	0.96
Grade 2	55	10.82	0.92
Grade 3	4	0.78	0.24
Grade 4	...	.....	....
Total	508		

TABLE 5.—*Comparison of the Percentage Frequency Distribution of the Four Grades of Fibrosis, Pus and Ulceration in the Entire Group of 10,000 Cases and in the 1,088 Cases with Cartilage and Bone*

	Grade 1		Grade 2		Grade 3		Grade 4	
Cases	Per Cent	Probable Error	Per Cent	Probable Error	Per Cent	Probable Error	Per Cent	Probable Error
Fibrosis								
10,000	11.08	±0.21	67.01	±0.32	20.77	±0.27	1.11	±0.06
1,088	2.29	±0.35	57.99	±1.14	36.58	±1.11	3.12	±0.40
Pus								
10,000	38.76	±0.33	56.85	±3.34	4.03	±0.13	0.32	±0.04
1,088	36.48	±1.11	60.29	±1.13	2.84	±0.39	0.36	±0.14
Ulceration								
10,000	34.79	±0.32	48.75	±0.34	15.28	±0.24	1.15	±0.07
1,088	28.76	±1.05	51.47	±1.16	18.65	±0.90	1.10	±0.24

tissue in relation to cartilage. Kellert,[22] although unable to recognize an increase in fibrous tissue, described the presence of varying amounts of pus cells in the crypts. Bilancioni [23] stated that pus cells in the

19. Babbitt, J. A.: Pathology of the Faucial Tonsil, Ann. Otol. Rhin. & Laryng. **16**:802, 1907.

20. Wood, G. B.: The Anatomy, Physiology and Pathology of the Tonsillar Structure in Relation to Cryptogenic Infections, Med. Rec. **98**:593, 1920.

21. Hillkowitz, Philip: The Occurrence of Cartilage in the Tonsil, Ann. Otol. Rhin. & Laryng. **33**:473, 1924-1925.

22. Kellert, Ellis: The Pathological Histology of Tonsils Containing Hemolytic Streptococci, J. M. Research **41**:387, 1920.

23. Bilancioni, G.: Aspetto clinico e istologia pathologica delle tonsille palatine, Stomatol. **22**:635, 1924.

crypts are common. Both he and Bell [24] noted an increase in the fibrous elements of certain tonsils. J. E. Davis [25] said that an exudation of leukocytes and a loss of stratified epithelium indicate a pathologic condition.

It is enlightening, however, to approach the subject of fibrosis, pus and ulceration from another angle. Age has been recognized as having some relation to fibrosis. Carmody [18] called attention to this by saying that he thought that the older the patient was the more connective tissue there would be. Wood [20] expressed the belief that the connective tissue varied in tonsils according to age. Dietrich [26] noted abundant forma-

TABLE 6.—*Percentage Frequency Distribution of Fibrosis According to Age Groups and Grades in the Entire Series of 10,000 and in a Subsidiary Group*

Age by Half Decades	10,000 Pairs of Tonsils — Grade, Per Cent				1,088 Pairs of Tonsils in which Cartilage or Bone, or Both, were Found — Grade, Per Cent			
	1	2	3	4	1	2	3	4
0- 4	9.74	2.32	0.33	.....	.....	0.95	0.50	.....
5- 9	19.58	5.4	1.01	0.90	4.0	1.26	0.25	.....
10-14	6.31	2.8	0.77	0.20	.....	0.31	.....	.....
15-19	10.28	5.89	2.64	2.70	12.00	3.32	1.00	5.88
20-24	12.72	12.1	6.16	3.6	8.00	7.29	5.27	2.94
25-29	9.83	13.26	8.71	6.30	8.00	11.72	7.78	2.94
30-34	10.74	14.68	11.94	10.81	12.00	15.68	8.29	14.70
35-39	7.4	12.75	14.54	9.90	16.00	15.84	14.07	8.82
40-44	5.23	10.80	14.10	10.81	12.00	14.58	18.09	8.82
45-49	2.88	8.64	13.43	13.51	16.00	12.36	11.80	14.70
50-54	3.06	5.82	10.92	18.91	.....	8.71	13.56	20.58
55-59	1.62	3.50	8.85	10.81	8.00	3.96	10.30	8.82
60-64	0.45	1.38	4.95	7.20	4.00	2.37	6.78	8.82
65-69	0.09	0.55	1.25	1.80	.....	1.26	1.25	2.94
70-74	.....	0.05	0.19	0.90	.....	0.31	0.50	.....
75-79	.....	.....	0.14	0.90	.....	.....	0.50	.....

	Mean	Standard Deviation	Probable Error	Mean	Standard Deviation	Probable Error
Grade 1	22.52	15.6	0.32	36.10	13.6	1.8
Grade 2	35.83	13.5	0.11	38.14	12.3	0.33
Grade 3	41.16	11.9	0.18	44.15	11.9	0.41
Grade 4	44.66	13.4	0.86	44.70	12.8	1.49

tion of bone in old age. Manchik [27] emphasized the same observation. The relationship of age to fibrosis, pus and ulceration in the entire group of 10,000 cases and in the groups in which cartilage and bone were found is included in tables 6, 7 and 8. It will be noted, in the group of 10,000 cases that for fibrosis graded 1 (table 6), the mean age is 22.52 years, while that in the group with cartilage and bone

24. Bell, H. H.: Further Observations on the Histopathologic Changes in the Excised Faucial Tonsils, Ann. Otol. Rhin. & Laryng. **33**:1224, 1924.

25. Davis, J. E.: The Pathology of the Tonsil, Ann. Otol. Rhin. & Laryng. **33**:657, 1924.

26. Dietrich, A.: Das pathologisch-anatomische Bild de chronischen Tonsillitis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **4**:429, 1922-1923.

27. Manchik, H.: Recherches sur le tissu cartilagineux des amygdales, Arch. internat. de laryngol. **1**:257, 1922.

is considerably greater, namely, 36.10 years. The mean age rises until in fibrosis, graded 4, the mean ages in the group of 10,000 and in the group of 1,088 cases almost exactly coincide. Because of the much lower mean age in the 10,000 in the lower grades, the advance was much more rapid than in the smaller group. The spread of standard deviation of the material for each grade of fibrosis is almost the same.

It should here be borne in mind just what is meant by the "spread." To the mean age in each case the number of years given as the standard deviation should be added as well as substracted in order to get an idea of the limits within which at least two thirds of the cases fall. It is clear, then, that if to the mean age of the cases with fibrosis

TABLE 7.—*Percentage Frequency Distribution of Pus According to Age Groups and Grades in the Entire Series of 10,000 and in a Subsidiary Group*

	10,000 Pairs of Tonsils				1,088 Pairs of Tonsils in which Cartilage or Bone, or Both, were Found			
	Grade, Per Cent				Grade, Per Cent			
Age by Half Decades	1	2	3	4	1	2	3	4
0- 4	3.25	2.28	3.22	6.25	0.50	0.76	3.22	.....
5- 9	6.78	5.52	5.70	3.12	0.50	1.06	3.22	.....
10-14	2.94	2.69	1.73	3.12	0.25	0.15	.....	.....
15-19	6.44	5.18	4.96	6.25	3.27	2.59	.....	.....
20-24	11.32	10.49	11.66	3.12	7.80	5.48	9.67	.....
25-29	12.46	11.57	10.42	9.37	12.34	8.84	3.22	.....
30-34	13.36	13.87	13.39	6.25	11.08	13.41	22.58	0.25
35-39	11.35	13.22	13.15	15.62	16.87	14.17	9.67	.....
40-44	10.21	11.30	11.16	6.25	13.09	16.61	25.80	0.25
45-49	8.51	9.50	7.44	9.37	13.09	12.19	3.22	0.25
50-54	6.44	6.75	8.68	9.37	9.06	11.58	9.67	0.25
55-59	4.28	4.59	4.46	12.50	6.56	7.01	3.22	.....
60-64	1.88	2.18	2.23	9.37	4.03	3.96	6.45	.....
65-69	0.61	0.61	1.73	.....	1.25	1.37	.....	.....
70-75	0.07	0.10	.....	.....	0.25	0.45	.....	.....
75-79	0.02	0.05	.....	.....	.....	0.30	.....	.....

	Mean	Standard Deviation	Probable Error	Mean	Standard Deviation	Probable Error
Grade 1	32.56	15.10	0.15	39.52	12.5	0.15
Grade 2	34.36	14.70	0.13	40.70	12.7	0.33
Grade 3	34.35	15.10	0.51	39.40	14.3	1.73
Grade 4	38.13	17.45	2.08	43.75	7.4	2.50

in grade 1 of the series in which cartilage and bone were found the standard deviation of 13.60 years is added as well as subtracted, most of the material falls between the ages of 22.50 and 49.70 years. In this grade, therefore, there are many tonsils from persons whose ages are even more than that of the mean ages of those with fibrosis, graded 4. This is pointed out merely as an example to demonstrate that although age is a definite factor in the production of fibrosis, it alone cannot be held accountable for the presence of increased amounts of fibrous tissue.

This principle is applicable to all the other grades. With the advance, in direct relation to the grade of fibrosis, from a mean age of 36.10 to 44.70 years in the group with cartilage and bone, and a corresponding but more rapid increase in the entire group from 22.52 to 44.66 years,

it is apparent that age must herein play some rôle. Thus, although fibrosis increases in amount independently of cartilage and bone, the two are associated in frequency. From this it might be concluded, with Carmody and Wood, that fibrosis varies with age, other considerations being excluded.

Table 7 gives similar data in relation to the presence of pus. No such relationship of age exists here as in fibrosis. When the amounts of pus present are compared, there seems to be no relationship in age between the entire group of 10,000 and the group of 1,088 cases in which cartilage and bone were found. An examination of the data presented in ulceration (table 8) reveals similar results. Ulceration,

TABLE 8.—*Percentage Frequency Distribution of Ulceration According to Age Groups and Grades in the Entire Series of 10,000 and in a Subsidiary Group*

Age by Half Decades	10,000 Pairs of Tonsils — Grade, Per Cent				1,088 Pairs of Tonsils in which Cartilage or Bone, or Both, were Found — Grade, Per Cent			
	1	2	3	4	1	2	3	4
0- 4	3.24	2.44	2.35	2.60	.....	0.89	1.47	.....
5- 9	7.01	5.35	5.56	9.56	0.31	0.89	1.47	8.33
10-14	2.73	2.66	2.87	5.21	0.31	0.17	.....	.....
15-19	0.07	5.33	3.86	1.73	2.55	3.21	1.97	.....
20-24	12.27	10.62	8.63	6.08	6.70	6.60	5.41	.....
25-29	11.95	12.45	10.07	7.82	9.26	11.42	7.38	.....
30-34	13.22	13.70	13.93	19.13	14.05	10.89	15.76	16.66
35-39	11.78	12.57	14.07	10.43	18.21	13.39	13.79	25.00
40-44	9.31	11.69	11.91	8.69	11.18	16.96	19.21	16.66
45-49	8.88	8.94	9.88	7.82	15.65	12.14	8.37	.....
50-54	6.12	6.74	7.59	12.17	8.94	11.25	11.82	8.33
55-59	4.11	4.41	5.56	5.21	7.34	5.71	6.40	25.00
60-64	1.60	2.25	2.61	2.60	4.15	3.92	5.41	.....
65-69	0.57	0.69	0.71	0.86	0.63	1.78	0.49	.....
70-74	0.05	0.06	0.26	.....	0.31	0.35	0.49	.....
75-79	0.02	0.04	0.06	.....	.....	0.35	.....	.....

	Mean	Standard Deviation	Probable Error	Mean	Standard Deviation	Probable Error
Grade 1	32.17	14.9	0.17	40.14	11.5	0.44
Grade 2	33.97	14.5	0.14	40.23	13.0	0.37
Grade 3	35.33	14.8	0.26	41.38	13.0	0.62
Grade 4	34.07	15.8	1.00	41.25	13.7	2.67

then, bears no relationship to age. From a comparison of these figures it can be concluded that fibrosis is directly related to age but that pus and ulceration are not. This theory is not new. The comparisons simply establish as fact wha has already been held as opinion.

From table 5, however, it is seen that fibrosis and ulceration are definitely increased in cases in which cartilage and bone are found and that in the same cases the amount of pus is slightly increased. From these observations it is apparent that one of the steps in the production of cartilage and bone is inflammation. Although the presence of ulceration and pus is not direct evidence that cartilage and bone will be found, infection, as indicated by pus and ulceration, is a direct cause of fibrosis and one of the primary factors in the production of cartilage and bone.

On the other hand, the presence of fibrosis is not necessarily an indication either of past inflammation or of the presence of cartilage and bone, for it represents a process which varies directly with age. If the process of infection is not the sole factor in the production of fibrosis, which evidently is increased in cases in which cartilage and bone are present, it is obvious that it cannot be concluded that infection alone is responsible for the production of these two observations. It can be concluded only that infection is one of the factors, but an important factor, as table 5 would indicate. Fibrosis, therefore, cannot be taken as alone indicative of previous inflammation but must be considered also in the light of age. In view of this, it is acceptable to believe that there must be at least some cases of fibrosis that have their origin either in rests or in the natural metaplastic ability of the unirritated connective tissue cells. After consideration of table 5, however, it seems probable that the most important factor is infection, for the evidence of the relationship among fibrosis, pus and ulceration, if these are indications of infection, and the presence of cartilage and bone, is undeniable. It is most tenable, therefore, that in the capsule, trabeculae and perivascular areas of the tonsil the tissue either is predisposed to change or has the potentialities to change into cartilage and bone under certain stimulating factors, and that foremost among such factors is infection.

Actinomycosis.—Of the 10,000 cases, 177 (1.77 per cent) were found to contain granules in the crypts which resembled those of actinomycosis. Those familiar with this particular aspect of pathologic changes of the tonsil may ask what the basis of selection was. Many tonsillar crypts contain collections of débris which obviously are not fungi of any sort. On the other hand, many crypts have accumulations of a type closely resembling those of actinomycosis. When granules like those of actinomycosis occurred in the crypts, but could not be proved to be such, the cases were classified under the heading of this fungus infection. Eighty-six of the 177 cases were in females and ninety-one in males. The youngest patient was a boy, aged 5 years; the oldest, a woman, aged 69. In fourteen of the 177 cases there were cartilage and bone. In four cases cholesterol was associated; in two, foreign bodies and calcareous degeneration; in two, tuberculosis, and in one, foreign-body giant cells. Figure 8 is illustrative of a usual case; the mass is fairly large, and the epithelium is intact. The central mass is represented by a dark area which apparently is what Weller [28] has called calcification. He found granules like those of actinomycosis third in order of frequency; in this series it is second. As stated

28. Weller, C. V.: The Incidence and Pathogenesis of Tonsillar Concretions, Ann. Otol. Rhin. & Laryng. **33**:79, 1924.

earlier, Davis [14] thought that as many as 30 per cent of extirpated tonsils contain such granules, but he [29] did not believe that true actinomycosis occurs in the tonsil of human beings. Castellani, Douglas and Thomson [30] expressed the belief that primary actinomycosis of the tonsil is rare. In 1904, Poncet [31] reported a case of tonsillar abscess followed by incision; later there was enlargement of lymph nodes in the neck, which on necropsy proved to be due to actinomycosis. Bell [32] found mycelial granules or granules like those of actinomycosis in 28 per cent of the cases; Grosevenor [33] reported 14 per cent, and Ruge [34] found four cases in twenty-five patients examined (16 per cent).

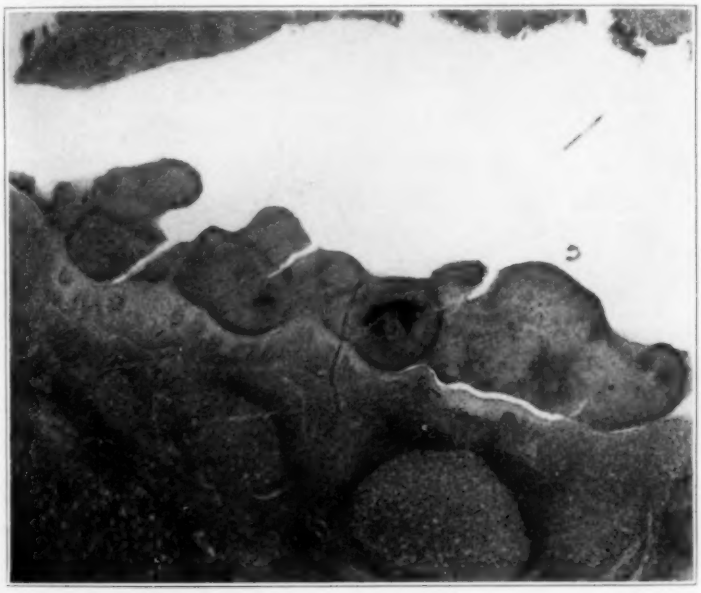


Fig. 8.—Section of tonsil, showing fungus-like mass in crypt with fibrosis 1; pus 2, and ulceration 1 (× 25).

29. Davis, D. J.: The Actinomyces-Like Granules in Tonsils, J. Infect. Dis. **14**:144, 1914.

30. Castellani, A.; Douglas, Mackenzie, and Thomson, T.: Further Observations on Tonsillomycoses, J. Trop. Med. **26**:19, 1923.

31. Poncet, M. A.: Actinomycose de l'amygdale; phlegmen cervical consécutif, Lyon méd. **102**:1166, 1904.

32. Bell, H. H.: Bacterial Flora on the Faucial Tonsils with Especial Reference to the Hemolytic Streptococci and Associated Histopathological Changes, Ann. Otol. Rhin. & Laryng. **33**:305, 1924-1925.

33. Grosevenor, L. N.: Actinomyces in Tonsillar Crypts, Illinois M. J. **19**:513, 1911.

34. Ruge, H.: Ueber Actinomyces, ahnliche Gebilde in den Tonsillen, Ztschr. f. klin. Med. **30**:529, 1896.

Ellis,[35] reporting on four cases, said that the bodies were never large in number and were invariably found in the crypts. He classified them with the ray fungus. In 1909, Beck [36] mentioned masses of leptothrix in the crypts which resembled the fungus. Bergey,[37] in his manual, said that there are at least sixty-five different types of actinomycosis, and that about ten of these are pathogenic. He classified leptothrix in the group of actinomycosis. Magath [38] did not believe that the granules seen in these tonsils are identical with those found in actinomycotic lesions elsewhere in the body. Stackman [39] and Fitch,[40] plant and veterinarian pathologists respectively, rendered an opinion concerning the granules which have been included in this group as being like those found in actinomycosis. The former, after comparing them with a number of cultures of actinomycosis, thought that there was a strong resemblance, but because of the varying morphology of *Actinomyces* no more committal statement was made. Fitch definitely stated that they were not the bovine type and doubted that they were a variety of *Actinomyces*. He expressed the belief, however, that they were probably a fungus. Of one thing there is certainty: the granules, whatever they are, are not pathogenic. They may belong to the group of *Actinomyces* which are nonpathogenic. These statements are not new. They have been the opinions of various previous writers. This paper simply adds new cases.

Tuberculosis.—This particular aspect of tonsillar pathology has attracted most attention from the standpoint of percentage frequency, although it seems that probably a good deal of the apparent discrepancy is on a basis of terminology. In fifty-two (0.52 per cent) of the 10,000 cases, tuberculosis of the diffuse type (fig. 9) was found. A cryptal type, which frequently has been described in the literature, could not be recognized. A record was made that the case was positive if in one or both of the tonsils there was evidence of the pathologic processes that were considered typical of diffuse tuberculosis, namely, central necrosis, epithelioid cells and a dustlike periphery. Twenty-three of the cases were in males and twenty-nine in females. The youngest patient was a girl aged 4 years, the oldest a woman aged 67. In two cases there were fungoid bodies in the crypts; in ten (19.23 per cent)

35. Ellis, J. W.: Actinomyces-Like Bodies in the Tonsils, J. A. M. A. **28**:1241 (June 26) 1897.

36. Beck, J. C.: Some Points in Anatomy, Pathology and Surgical Treatment of the Faucial Tonsils, Ann. Otol. Rhin. & Laryng. **18**:38, 1909.

37. Bergey, D. H.: Manual of Determinative Bacteriology, Baltimore, Williams & Wilkins Company, 1925, p. 462.

38. Magath, T. B.: Personal communication to the author.

39. Stackman, E. C.: Personal communication to the author.

40. Fitch, C. P.: Personal communication to the author.

there were varying degrees of cartilage and bone. This is interesting in view of the fact that there were cartilage and bone in only 11.21 per cent of the entire 10,000 cases. Here and there, in the writings on this subject, statements are seen that the amounts of cartilage and bone are increased, or at least are more frequently encountered in tonsillar tuberculosis than in the average run of tonsils. Many claim that this is not so. Certainly in this group the percentage frequency of cartilage and bone is definitely increased in the cases of tuberculosis.

Although considerable variance of opinion exists as to the frequency of tuberculosis in tonsils, a large group of investigators place the figure

Fig. 9.—Section of tonsil, showing diffuse tuberculosis with fibrosis 2; pus 2, and ulceration 2 (× 100).

at about 5 per cent. Among these observers are Howarth and Gloyne,[41] Sewall,[42] Willis [43] and Wood and Case.[44] Holsti [45] found a frequency

41. Howarth, W. G., and Gloyne, S. R.: The Nature and Pathology of Infection in the Tonsil, J. Laryngol. Rhinol. & Otol. **39**:429, 1924.

42. Sewall, E. C.: Histologic Examination of the Faucial Tonsils with Reference to Tuberculosis, J. A. M. A. **57**:868 (Sept. 9) 1911.

43. Willis, B. C.: Inflammatory Pathology of the Tonsil, South. M. J. **7**:747, 1914.

44. Wood, G. B., and Case, E. A.: Tonsillar Pathology in Relation to Systemic Infection, Ann. Otol. Rhin. & Laryng. **33**:958, 1924.

45. Holsti, O.: Bidrag til kännedomen om tonsillerna vid de reumatiska ledgangsaffektionerna. En pathologisk-anatomisk och klinisk studie, Finska läk.-sällsk. handl. **66**:365, 1924.

of approximately 8 per cent. Crowe, Watkins and Rothholz [46] examined 1,000 cases and found 4.6 per cent positive. They stated further that all cases of foreign-body giant cells were carefully excluded. Barnes,[47] in his monograph on tonsils, stated his belief that the incidence of tuberculosis in tonsils is about 6 per cent, although in a series which he examined he was able to find only three in 150 cases. Morris [48] cut 2,321 tonsils longitudinally and found tuberculosis of both the cryptal and the diffuse type together in 1.7 per cent. In 1910, Judd [49] noted tubercles in much less than 1 per cent in several hundred tonsils examined, but in 1,000 cases 2.3 per cent were positive. Weller [12] gave a frequency of 2.35 per cent for tuberculosis in general, with 0.18 per cent for the diffuse type.[50] In the latter group he included only those cases in which the process was present definitely in both tonsils, with approximately uniform distribution and involvement of the lymph follicles. As only the diffuse type was recognized in this series, a comparison on this basis only can be made with Weller's percentage. In seventeen (0.17 per cent) of the 10,000 cases, the process was present in both tonsils. Thirty-five (0.35 per cent) had the process only in one tonsil. This is only 0.01 per cent lower than Weller's corresponding percentage.

These percentages are even more evidently corroborative when it is recalled that Weller's [50] group of 8,697 cases was collected for the period between 1906 and 1919. All forms of tuberculosis have been on the decline in recent years. It would be expected that the percentage for tuberculosis would be less for the years from 1923 to 1927 than for those from 1906 to 1919. In order to verify the assumption that tonsillar tuberculosis, of the diffuse type at least, is on the wane, 600 cases collected from the year 1900 were examined by the same methods as those used in examining the 10,000. The percentage in these cases was 1.33. Apparently, tuberculosis of the tonsils is on the downward trend and all that is needed to establish this and to effect an agreement on percentages is an understanding of the criteria which each investigator is using.

---

46. Crowe, S. J.; Watkins, S. S., and Rothholz, A. S.: Relation of Tonsillar and Nasopharyngeal Infections to General Systemic Disorders, Bull Johns Hopkins Hosp. **28**:1, 1917.

47. Barnes, H. A.: The Tonsils; Faucial, Lingual, and Pharyngeal: With Some Account of the Posterior and Lateral Pharyngeal Nodules, St. Louis, C. V. Mosby Company, 1914, p. 17.

48. Morris, A. G.: Clinical and Pathological Study of Tonsil Cases, Ann. Otol. Rhin. & Laryng. **32**:864, 1923-1924.

49. Judd, E. S.: Treatment of Tuberculous Glands of the Neck, Ann. Surg. **52**:758, 1910.

50. Weller, C. V.: Personal communication to the author.

Cholesterol.—In sixty-three (0.63 per cent) of the 10,000 cases, evidences of cholesterol were found. The crystals themselves, due to the process of fixation, were dissolved out, leaving areas as seen in figure 10. These occurred singly or in multiples. Twenty-six cases were in males and thirty-seven in females. The youngest patient was a boy aged 4 years, the oldest, a man aged 72. In four cases (6.35 per cent), there was cartilage and bone; in one there was a foreign body in one of the crypts. In seventeen cases (27 per cent) foreign-body giant cells were associated. Considering that altogether only twenty-nine cases of foreign-body giant cells were found, it is obvious that these cells in tonsils must have some definite relationship

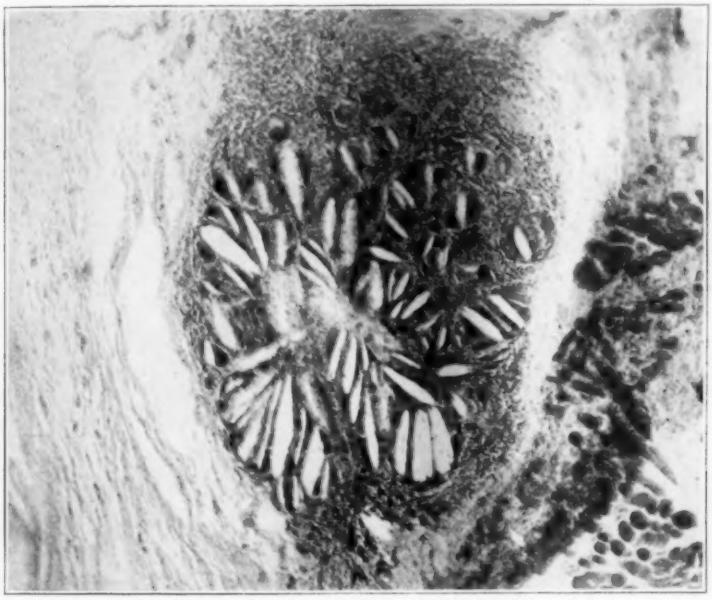


Fig. 10.—Section of tonsil, showing area of cholesterol crystals and foreign-body giant cells with fibrosis 3; pus 2, and ulceration 2 (× 50).

with tonsillar cholesterol. For a long time this substance has been found commonly in chronic inflammation. It is seen in chronic otitis media and often is encountered in the gallbladder. It is frequently observed in large quantities in degenerating thyroid glands. In fact it may be said to occur in almost any place in which a chronic degenerative inflammatory process is going on. North,[51] Kellert [22] and Barnes [47] mentioned cholesterol in the tonsils. Maffeo [52] estimated that tonsils

51. North, John: The Physiology and Pathology of the Tonsils, J. A. M. A. **19**:451 (Oct. 15) 1892.

52. Maffeo, Luigi: Sul contenuto colesterinico delle tonsille faringea e palatina, Riforma med. **39**:146, 1923.

contained between 0.001 and 0.087 per cent of cholesterol. Its presence, according to Weller,[28] may have something to do with lipoid degeneration or with the process of the production of soap. It would be expected that the percentage of cartilage and bone in this group would at least exceed 11.21 per cent, if inflammation is a factor in the production of these tissue elements. Giant cells and cholesterol, however, usually are associated with marked degenerative inflammation in which necrosis is often present. This is different from the low-grade inflammatory process seen in most tonsils. Cholesterol in the tonsils, and its occurrence in chronic degenerative processes, have been noted

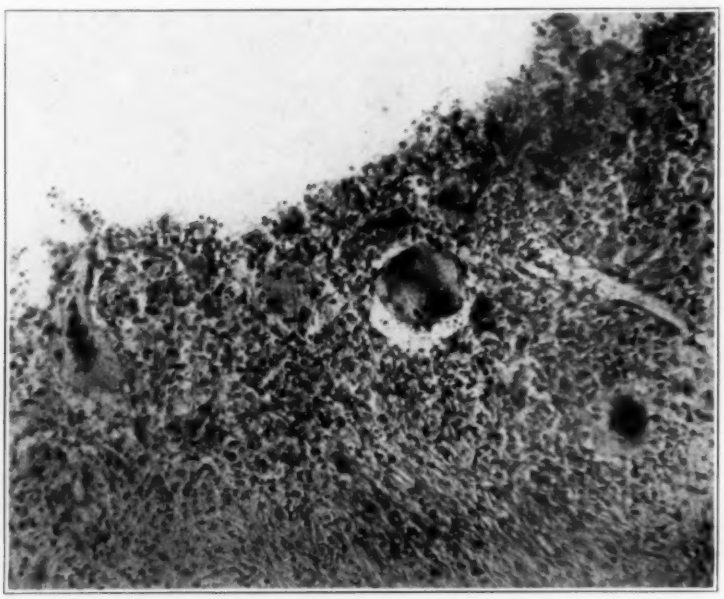


Fig. 11.—Section of tonsil, showing foreign-body giant cells surrounding a crypt (× 200).

frequently. This study simply offers a percentage frequency which has not been seen in the literature before and emphasizes the common occurrence of this crystal with foreign-body giant cells.

Foreign-Body Giant Cells.—Giant cells were present in twenty-nine cases (0.29 per cent). When present there usually were many of the foreign-body type and they were always situated around the crypts (fig. 11) or regions in which there was cholesterol. This type of cell probably led some investigators to call the condition tuberculous. In recent years the structure has been recognized as a foreign-body giant cells and is known to have no particular connection with tuberculosis. In most cases there was evidence of a marked chronic inflammatory process

in the region in which the giant cells were found. Significant of this is the fact that cholesterol was found in seventeen of these cases (60 per cent). It is known that foreign-body giant cells, cholesterol and chronic inflammation commonly are associated. In two cases there were cartilage and bone; in one there was a foreign substance in the crypts and in one a fungus; in the remaining eight cases nothing significant was found.

Trichina.—This series yielded six cases in which *Trichina* was found (fig. 12). The parasite was always found in the capsular tissue or trabecular fibrous and muscle septums. There apparently has been

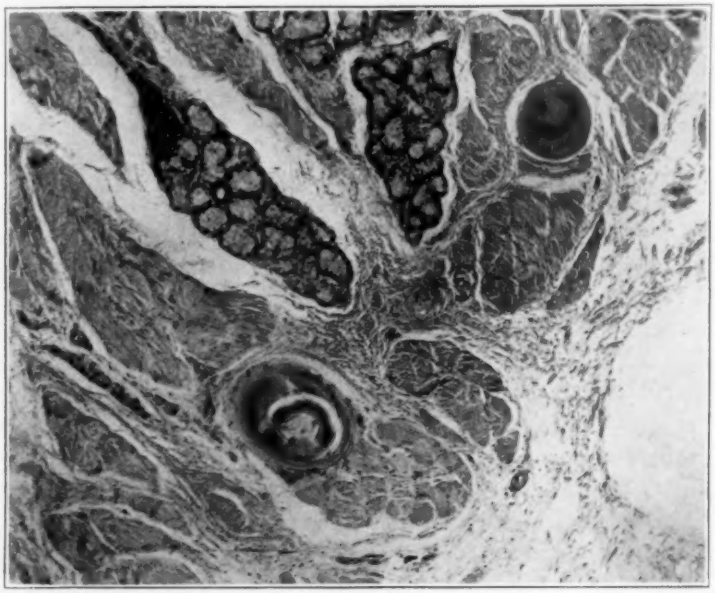


Fig. 12.—Section of tonsil, showing trichinae in musculature of capsule, with fibrosis 2; pus 2, and ulceration 2 (× 100).

no mention in the literature of *Trichina* being found in the extirpated tonsil, but probably any one who has examined a large number of tonsils has found this organism. Aikman [53] said that *Trichina* is found in striated muscles, the vascular supply of which is most abundant; he mentioned the muscles of the neck and the tongue as elective sites. It would be most natural to presume that the trichinae would be found in the region of the tonsils, for this area is rich in blood vessels. Perhaps serial sectioning would have brought forth a higher frequency than 0.06 per cent.

53. Aikman, John: Trichinosis in Children, New York State J. Med. **26**:20, 1926.

As may be noted in table 2, many other abnormalities were found. Ten cases of stones in the crypts were noted. Stones in the crypts of the upper and lower poles would be missed, owing to the method of sectioning. At the time of operation some stones may have been expressed. During sectioning, the knife might hit gritty material and a stone be presumed to be present but none found. The acuity and conscientiousness of the technician whose interest is not in observation, had to be relied on in recording the incidence of stones. From clinical experience, however, this percentage seems exceedingly low. Weller [28] found 8 per cent, and this sounds reasonable. The frequency of tonsilloliths, although not high, is not rare. Because the majority of these tonsils was removed for reasons that had to do with focal infection, it is possible that if marked local disease is responsible for the production of stones, the percentage would be low.

Eight cases showed foreign substance in the crypts, some associated with considerable detritus. Part of these were easily recognized as vegetable particles, whereas others were not identified.

Peritonsillitis was present in five cases. Tonsillectomy was not attempted in cases in which there had been recent local infection. Several weeks, at least, were allowed between complete quiescence and operation. These were probably cases which were seen at the onset, when local signs and symptoms were not evident.

There were four cases in which abscesses were found and two in which cysts were discovered. This incidence is low, for from clinical observations it seems that cysts occur frequently. Many cysts are known to have been broken at the time of operation. Allen,[54] Finder [55] and Ritter [56] have offered the theory that cysts are due to blocked or sealed crypts, with subsequent retention and gradual accumulation. There seems to be no reason for believing otherwise.

Calcareous degeneration occurred in two cases.

Two cases of squamous cell epithelioma were found. Neither of these was diagnosed, either before or at the time of operation. Epithelioma of the tonsil is by no means unusual. The significance here lies only in the fact that the epitheliomas were discovered inadvertently in the course of examination.

One case of lymphosarcoma was noted. At the time of operation the local picture apparently was unusual, for one tonsil was sent for bacteriologic examination, thus leaving only one for sectioning.

---

54. Allen, H.: Cystic Tonsil, Tr. Path. Soc. Phila. **4**:68, 1874.

55. Finder, G.: Zur pathologischen Anatomie der Tonsills, Arch. f. Laryngol. u. Rhinol. **7-8**:351, 1898.

56. Ritter, Hans: Ein Beitrag zur pathologischen Anatomie der Gaumenmandeln, Arch. f. Laryngol. u. Rhinol. **13-14**:121, 1903.

There was one case of hemangio-endothelioma, which was of an angiosarcomatous type. In one case there was marked hyperplasia of the cryptal epithelium. The condition possibly was malignant. On examination, however, characteristics of squamous cell epithelioma were not found. The cells were completely differentiated and the basement membrane was well defined. In one case there was blood pigment beneath the epithelium; in one there was pigmentation of the crypts; in one marked ulceration of the surface of one tonsil, and in one marked obliterative endarteritis which was suspected of being syphilitic in origin, but this was not confirmed.

CONCLUSIONS

1. All tonsils show evidence of chronic infection, if the presence of leukocytes in the crypts and ulceration of the epithelium are an indication of infection.

2. In 14.27 per cent of tonsils there are pathologic changes of bizarre types.

3. In 11.21 per cent of tonsils there are cartilage and bone in various grades and proportions.

4. Cartilage occurs in relatively larger amounts than bone.

5. Chronic infection is a great and definite factor in the production of fibrosis.

6. Fibrosis is relatively increased in cases in which there is cartilage and bone.

7. Chronic infection is an inciting factor in the production of cartilage and bone.

8. Fibrosis increases independently of infection and in direct relationship to age.

9. Bodies similar to those found in cases of actinomycosis occur second in order of frequency in pathologic conditions of bizarre type in the tonsil.

10. Tuberculosis of the diffuse type has an incidence of 0.52 per cent, and is on the decline.

11. In 0.17 per cent of tonsils there is bilateral involvement with tuberculosis.

12. The percentage frequency of occurrence of cartilage and bone is increased in cases of diffuse tuberculosis of the tonsils.

13. Cholesterol can be seen in 0.63 per cent of tonsils.

14. Foreign-body giant cells and cholesterol are associated with each other in chronic degenerative processes of the tonsils.

15. Trichinae are present in 0.06 per cent of extirpated tonsils.

16. There is sufficient pathologic change of interest in the tonsils to warrant routine microscopic examination of removed tonsils.

THE RELATIONSHIP OF SINUSITIS AND BRONCHIECTASIS *

LESTER H. QUINN, M.D.
AND
OVID O. MEYER, M.D.
MADISON, WIS.

The common association of sinusitis and bronchiectasis has been noted repeatedly in the past decade; the literature is mainly distributed in the journals of otolaryngology. Despite this fact, it is not yet well enough known that some patients with symptoms suggesting pulmonary tuberculosis but with repeatedly negative sputums may have bronchiectasis, usually associated with chronic infection of the upper respiratory tract. Far too often these patients are treated for long periods in sanatoriums for tuberculous patients. Within the past year two patients have been observed who spent six and eight years, respectively, receiving treatment for tuberculosis; both had fairly advanced bilateral bronchiestasis with pansinusitis. In one of these cases the patient denied that any investigation of the sinuses had been carried out during the period of years at the sanatorium.

The French were among the first to recognize the common occurrence of chronic pulmonary infection in association with nasal and sinus disease. Rist [1] noted many cases of chronic bronchitis among soldiers and recognized the importance of disease of the upper respiratory tract in these cases. He compared the respiratory tract to the urinary tract in which cystitis follows renal infection. At this time, both Rist and Sergent [2] insisted that correction of the nasal disease brought about cure of the bronchitis.

In 1921, in this country, Webb and Gilbert [3] recognized the importance of sinusitis in association with chronic disease of the lungs not due

* Submitted for publication, April 22, 1929.

* From the State of Wisconsin General Hospital, University of Wisconsin.

1. Rist, E.: Les principles du diagnostic rationnel de la tuberculose pulmonaire, Presse méd. **24**:305 (July) 1916; Les diagnostic différentiel la tuberculose pulmonaire et les affections chroniques des fosses nasales, ibid. **24**:321 (July) 1916.

2. Sergent, Emile: Histoire suggestive de quelques faux tuberculeux diagnostic différentiel de la tuberculose pulmonaire et des affections des voies respiratoires supérieures, Bull. et mém. Soc. méd. d. hôp. de Paris **40**:1424 (July 28) 1916; Considerations sur la statistique du centre de triage; la charité le vesinet, de juin 1916 à décembre 1917, J. de méd. chir. prat. **89**:643, 1918.

3. Webb, G. B., and Gilbert, G. B.: Bronchiectasis and Bronchitis Associated with Accessory Sinus Disease, J. A. M. A. **76**:714 (March 12) 1921.

to tuberculosis. They advised roentgen examination of the sinuses in all these cases. In their opinion, bilateral empyema of the antrums was most frequently found. The pus found in washings usually showed pneumococci such as were found in the sputums. They found that the long-standing cases did not show as great improvement from sinus treatment as the early cases.

In the same year, Mullin [4] made the statement that patients with bronchiectasis will usually be found to have well marked sinusitis, usually pansinusitis. In his opinion, the tendency for patients with bronchitis is to get well unless the condition is fostered and fed by a chronic sinus infection.

In 1923, McIntire [5] reported thirty-seven cases of pulmonary disease associated with disease of the nasal sinuses, and he concluded that a definite pulmonary infection may result from sinus disease.

The frequency with which the cases of bronchitis and bronchiectasis are associated with sinusitis varies in different reports. Dunham and Skavlem [6] found sinus disease in twenty-five cases of bronchiectasis, excluding cases due to foreign body, syphilis and the like, in which the etiology was definite. Kistner [7] reported 196 cases of chronic nontuberculous bronchitis in patients between the ages of 4 and 71, in all but six of which definite chronic sinus disease was demonstrated. Dennis [8] reported that in fifty-two patients with bronchiectasis or asthma, forty-seven had involvement of the maxillary sinus. In these cases, however, macroscopic pus was found only thirteen times; in the vast majority of cases there were hyperplastic changes in the mucosa. In 1927, Dunham and Skavlem [9] reported twenty-six cases of bronchiectasis; in nineteen, or 73 per cent, there was infection in the upper air passages. In each of the other seven cases there was a definite history of gas exposure, severe influenza or empyema. Schwartz and Weiner [10] reported finding sinus disease, most often infected antrums, in six

4. Mullin, H. V.: The Accessory Sinuses as an Etiologic Factor in Bronchiectasis, Ann. Otol. Rhin. & Laryng. **30**:683, 1921.

5. McIntire, R. T.: Pulmonary Symptoms Incident to Infection of the Accessory Sinuses of the Nose, U. S. Nav. M. Bull. **13**:688, 1923.

6. Dunham, Kennon, and Skavlem, J. H.: Sinus Diseases and Lung Infections, J. Radiol. **4**:37 (Feb.) 1923.

7. Kistner, F. B.: Infections of Accessory Nasal Sinuses as the Cause of Chronic Non-Tuberculous Bronchitis, Northwest. Med. **26**:203 (April) 1927.

8. Dennis, F. L.: Accessory Nasal Sinus Infection with Complications: An Analysis of Cases Associated with Asthma and Non-Tuberculous Chest Lesions, Ann. Otol. Rhin. & Laryng. **33**:451 (June) 1924.

9. Dunham, Kennon, and Skavlem, J. H.: Chronic Non-Tuberculous Infections, U. S. Vet. Bur. M. Bull. **3**:861 (Sept.) 1927.

10. Schwartz, M., and Weiner, H. L.: Relationship of Chronic Bronchitis and Bronchiectasis to Paranasal Sinus Infection, Ann. Med. **33**:623 (Oct.) 1927.

cases of chronic bronchitis and in sixteen cases of chronic bronchitis associated with bronchiectasis.

On reviewing the cases of bronchiectasis (table 1) from all causes, we found sinusitis to be of frequent occurrence, but less common than has been reported previously. The coexistence, however, is so frequent that investigation of the sinus is never to be neglected in cases of bronchiectasis unless, of course, the cause is evident; for example, when a foreign body is known to exist. Definite sinusitis was found to exist in twenty-two, or 57.9 per cent, of the thirty-eight cases in table 1.

On studying this group with associated sinusitis, one notes that the cases are about equally divided among the sexes, twelve patients being females and ten males. The average age of the patients was 23.45 years, half of them being under 20, however, and 73 per cent under 30. The youngest patient was 9, the oldest 66. The average duration of symptoms was 5.7 years; the average age of onset, 18.18. Various symptoms and illnesses preceded the apparent onset of the disease itself. In seven, or 31.8 per cent, there was a history of pneumonia alone or associated with influenza and empyema. In five, or 22.7 per cent, the patients dated the symptoms from the time of influenza. In six cases, the anamnesis allows no conclusions as to the possible exciting causes. In seventeen, or 77.2 per cent, bilateral bronchiectasis was present; in two of these the involvement on the right seemed greater than on the left, and in three cases the opposite seemed true. Of the five unilateral cases, three were right-sided, while in the other two the left side was involved. Six, or 27.3 per cent, were cases of mild or early bronchiectasis; ten, or 45.4 per cent, were moderately advanced, and the other six, advanced or far advanced. The decision as to the degree of bronchiectasis was based on the general constitutional disability, the local subjective and objective symptoms and the roentgen observations. Difference of opinion here, it must be admitted, might occur in some borderline cases. In seventeen of the twenty-two cases the diagnosis of bronchiectasis was confirmed by roentgen examination following insufflations of iodized oil 40 per cent. Twenty, or 90.9 per cent, of the twenty-two patients had involvement of the maxillary sinus alone or in conjunction with other sinuses; seven had pansinusitis. In this series, no direct relationship was determined between the degree of sinusitis and the degree of bronchiectasis. In fifteen of the cases tonsillectomies had been done; however, in one-third tags persisted.

From this series it is not possible to conclude, as does Adam,[11] that bronchiectasis due to sinusitis is almost always in the right lung. He compared the inhalation of pus to the inhalation of any foreign

11. Adam, James: Bronchiectasis of Inhalatory Origin, Tr. Med.-Chir. Soc. Glasg. **21**:143 (April 8) 1927.

TABLE 1.—*Cases of Bronchiectasis with Coexistent Sinusitis*

Number	Name	Sex	Age	Age at Onset, Years	Duration of Symptoms	Type of Onset	Type of Bronchiectasis	Status	Iodized Oil	Type of Sinusitis	Tonsils
1	J. T.	M	36	36	3 mo.	With pleurisy	Bilateral	Moderately advanced	Yes	Bilateral maxillary	Out
2	A. S.	F	20	14	6 yr.	Unknown but symptoms worse since pneumonia in 1926	Bilateral	Moderately advanced	Yes	Pansinusitis	Diseased, enlarged, cryptic
3	P. H.	F	37	31	6 yr.	Influenza at age of 31	Bilateral	Moderately advanced	No	Pansinusitis	Removed
4	L. B.	F	18	12	6 yr.	Repeated upper respiratory infections	Right	Moderately advanced	Yes	Bilateral maxillary	Tags
5	M. A.	F	15	15	1 mo.	With cough and fever one month before admission	Left	Early, mild	Yes	Bilateral maxillary	Removed eight years ago
6	F. P.	F	17	11	6 yr.	Influenza	Bilateral	Moderately advanced	Yes	Pansinusitis	Tag on right
7	L. G.	M	19	12	7 yr.	Pneumonia three times, last at the age of 12	Bilateral	Far advanced	Yes	Maxillary and ethmoids; polypi	Removed
8	N. H.	M	18	14	4½ yr.	Bronchopneumonia after appendectomy	Bilateral	Far advanced	Yes	Pansinusitis; polypi	Tags
9	L. E.	F	32	23	9 yr.	Influenza and pneumonia	Bilateral	Far advanced	Yes	Pansinusitis	Good
10	L. W.	M	11	10	4 mo.	Lobar pneumonia 4½ mos. ago; empyema-fistula	Left	Moderately advanced	No	Bilateral maxillary	Enlarged
11	J. G.	F	12	5	7 to 8 yr.	Unknown	Bilateral L>R	Moderately advanced	No	Bilateral maxillary	Removed at age of 9
12	S. W.	F	30	14	16 to 17 yr.	Childhood "catarrh"	Bilateral	Mild	No	Bilateral maxillary	Cautery of tonsils; tag on right
13	M. K.	F	10	7	2½ yr.	Pneumonia and empyema	Bilateral	Mild	Yes	Bilateral maxillary	Removed
14	D. Mc.	M	66	66	3 mo.	Cough of unknown etiology	Right	Mild	Yes	Ethmoiditis	Small submerged type
15	R. B.	M	22	21	1 yr.	Cough ten years; productive one year	Bilateral L>R	Mild	No	Pansinusitis	Removed
16	E. H.	F	26	21	6 yr.	Influenza	Bilateral L>R	Moderately advanced	Yes	Bilateral maxillary	Removed
17	H. H.	M	44	42	2 yr.	Unknown	Bilateral R>L	Moderately advanced	Yes	Nasal polyps; ethmoid ?	No record
18	R. H.	M	9	2	7 yr.	Following tonsillectomy	Bilateral	Moderately advanced	Yes	Bilateral maxillary	Removed at age of 2 years
19	F. B.	F	21	18	2 yr. 8 mo.	Influenza	Right	Mild	Yes	Pansinusitis; left maxillary treated two years ago	Removed
20	C. H.	F	25	18	7 yr.	Influenza	Bilateral R>L	Advanced	Yes	Bilateral maxillary, slight clouding of frontals	Atrophic
21*	D. B.	M	16	2	14 yr.	Unknown	Bilateral	Advanced	Yes	Bilateral maxillary, R>L; history of mother and grandfather having similar productive coughs of many years' duration	Tags
22	R. B.	M	12	6	At least 6 yr.	Unknown	Bilateral	Advanced	Yes	Bilateral maxillary	Contacts; removed

* The patients in cases 21 and 22 were brothers.

body, in which the right lung is oftener the one involved because of its greater accessibility by way of the bronchus.

Sixteen of the thirty-eight patients had no evidence of sinusitis. These are grouped in table 2.

It is noted here that the male sex predominates, 10:6. The average age is much greater—37.5 years—the range being from 8 to 51. The average age of onset is also greater, 34.9, while the average duration of symptoms is slightly shorter 5.1 years. Only 12.5 per cent of these patients were under 20 at the time of admission to the hospital. Pneumonia, influenza and colds were the most common conditions which preceded the bronchiectasis. Nine of the sixteen cases were bilateral. In four of the remaining seven, the left lung alone was involved, while in the other three, including the case with foreign body, the right lung was involved. Three of the cases were early or mild in degree of bronchiectasis, six were moderately advanced and seven advanced or far advanced. Insufflations of iodized oil were done in eleven of these cases, and the diagnosis was thus proved. Fifteen of the sixteen patients still had their tonsils at the time they came under observation.

A comparative reference is given in table 3.

On reviewing twelve other cases of chronic bronchitis without demonstrable bronchiectasis, we found that sinusitis was found in only four, or 33.3 per cent. Of the others, five patients had diseased tonsils, one of these in association with sinusitis, one patient had only rhinitis as a possible demonstrable focus and another only chronic otitis media. In the other patient no possible focus was determined.

It might be stated that all the patients with bronchiectasis and bronchitis listed, without exception, had roentgen examinations of the sinuses and had been examined by a competent rhinologist one or more times during residence in the hospital. The diagnosis of sinusitis was made when pus was found macroscopically, in the patients with antrum infection, by puncture and irrigation. The large majority had no subjective symptoms of sinusitis and only a few complained of nasal or postnasal discharge. It is realized, of course, that a sinus infection may have previously existed in many of the patients with bronchitis and bronchiectasis listed, and that the infection may have cleared up before the patient came under our observation; consequently, the absence of sinus infection at the time of admission to the hospital does not necessarily rule out its previous existence.

It is the belief of some that the sinusitis may be secondary to the bronchiectasis or bronchitis, but a great majority believe that the opposite is true or that their onset is simultaneous with some acute infection. That is, with the infection both sinusitis and acute bronchitis develop, the latter, which has a tendency to heal, remains instead as a

TABLE 2.—*Cases of Bronchiectasis Without Demonstrable Sinusitis*

Number	Name	Sex	Age	Age at Onset, Years	Duration of Symptoms	Type of Onset	Type of Bronchiectasis	Status	Iodized Oil	Septic Tonsils
1	W. J.	M	40	38	2 years, 2 months	Undetermined, worker at emery wheel	Bilateral	Moderately advanced	Yes	Yes
2	N. D. B.	F	34	6	28 years	Measles and pneumonia	Bilateral	Advanced	Yes	Yes
3	G. C.	F	32	27	5 years	Operation for mastoid abscess at age of 10 years	Biltaeral	Mild	Yes	Yes
4	O. F.	M	49	48	6 months	Influenza, pneumonia, empyema	Left	Moderately advanced	Yes	Yes
5	P. H.	M	41	40	1 month	Recurrent influenza	Bilateral	Advanced	Yes	Yes
6	L. H.	M	17	15	2 years	Dry bronchitis; pneumonia	Bilateral	Advanced	Yes	Yes
7	G. P.	M	58	55	3 years	At 37 years, pneumonia; 17 years, pneumonia; 13 years, pleurisy; for three years had had dyspnea and cough	Bilateral	Advanced	Yes	Yes
8	H. J.	F	59	47	12 years	Undetermined	Bilateral	Advanced	Yes	Yes
9	A. F.	F	47	47	3 weeks	Unresolved pneumonia; had influenza two years ago, followed by cough for two months	Right	Mild	No	Yes
10	J. G.	M	68	67	9 months	Severe cold	Left	Moderately advanced	No	Yes
11	W. F.	M	20	17½	2½ years	Frequent colds	Left	Advanced	Yes	Yes
12	R. G.	M	8	3	5 years	Unresolved pneumonia; asthma and bronchitis since then	Bilateral, Left>Right	Moderately advanced	No	Yes
13	W. D.	M	51	41	10 years	Undetermined	Right	Advanced	No	Yes
14	N. G.	F	20	19	5 months	Cold and cough	Left	Moderately advanced	No	No
15	H. V.	M	21	20	8 months	Cold with persistent cough	Bilateral	Mild	Yes	Yes
16*	F. Mc.	F	36	35	1 year, 2 months	Productive cough following dental extractions under general anesthesia	Right	Moderately advanced	Yes	Yes

* Foreign body—tooth found.

chronic infection because of persistent drainage and aspiration of infective material into these bronchi from the upper respiratory tract. Mullin [4] offered this as one explanation. He objected to the statement that infection occurred from the bronchi to the sinuses, since there is no ready route and because the number of patients with cough and moist rales at the bases of the lungs, especially children, who get well after early diagnosis and treatment of the sinuses, is great. Kistner [7]

TABLE 3.—*A Comparison of the Groups with and without Concomitant Sinusitis*

	Sinusitis Group		Nonsinusitis Group	
	Number	Percentage	Number	Percentage
Age				
Female	12	54.6	6	37.5
Male	10	45.4	10	62.5
Average age on admission	23.45 years		37.5 years	
Under 20 years		50		12.5
Under 30 years		73		31.2
Average duration of symptoms	5.7 years		5.1 years	
Average age at onset	18.18 years		34.9 years	
Under 20 years		68.2		31.2
Under 30 years		82		46.6
Type of Onset				
Pneumonia	7 (Influenza 1, Empyema 2, Measles 0)	31.8	6 (Influenza 1, Empyema 1, Measles 1)	37.5
Influenza	5	22.7	1	6.25
Pleurisy	1		0	
Childhood "catarrh"	1		0	
Colds	1		4	
Unknown	6		4	
Foreign body	0		1	
Tonsillectomy	1		0	
Type of Bronchiectasis				
Bilateral	17	77.2	9	56.2
Right	3	13.7	3	25
Left	2	9.1	4	18.8
Degree of Involvement				
Early or mild	6	27.3	3	18.8
Moderately advanced	10	45.4	6	37.5
Advanced or far advanced	6	27.3	7	43.7
Tonsils				
Diseased	3	13.7	15	93.3
Tags	5	22.7		
Removed, cleanly	10	45.4	1	6.7
Apparently not diseased	3	13.7		
No record	1	4.5		
Type of Sinusitis				
Pansinusitis	7			
Bilateral maxillary	13			
Ethmoiditis	3			
Polypi	3			

expressed the belief that chronic bronchitis usually begins in childhood coincident with sinus infection and that the sinus drainage persistently reinfects the bronchi. Dennis [8] also believed that bronchitis and sinusitis developed at the same time.

The belief has been quite generally held that aspiration of infective material which had drained from the sinuses into the nares, particularly in droplet form, was possible, and it has been assumed that this aspiration probably occurred chiefly when the person was asleep or at least recumbent. That this aspiration in the human being does occur has not been

proved though certainly the logic of this explanation is unquestioned, and in experimental animals it has been demonstrated by Mullin and Ryder [12] that inhalation of india ink and suspensions of tubercle bacilli placed in the antrums and nares was possible. After the introduction of india ink, they found post mortem, black spots all along the respiratory tract with discoloration of the bronchial nodes and the lungs. Tuberculous pulmonary involvement was found when tubercle bacilli were aspirated. Pneumococcic pus from infected antrums of human beings was placed in the antrums of rabbits, and inflammation of the maxillary sinuses, intense tracheitis, bronchitis and pneumonia resulted. These workers also placed ink and tubercle bacilli in the sinuses and, with drainage into the nares not permitted, found that involvement of the lungs followed. They explained this on the basis of lymphatic absorption from the sinus by way of the submaxillary and internal jugular nodes, which later include the analogue of the retropharyngeals in man, to the lymph ducts, the great veins, the right side of the heart and the lungs. They found that absorption from the frontal sinus seemed to follow the same course as absorption from an antrum. They also decided as a result of their experimental study that the lining membrane of the nasal fossae and accessory sinuses is a continuous whole from the standpoint of anatomic and lymphatic function, and infection at one point can probably be conveyed by the lymphatics to practically any other point. In the opinion of these authors, "drainage of the sinuses into the upper air passages renders the bronchi and lung liable to infection by inhalation, and this factor may be as important as lymphatic metastases in accounting for the clinical association of sinus disease with broncho-pulmonary disease, though in non-draining cases it seems to be excluded."

Corper and Robin,[13] following the technic of Mullin and Ryder, dropped nasal instillations of india ink into ether anesthetized rabbits placed in the horizontal position on their back with the head slightly elevated. It was shown on postmortem examination that the india ink easily entered the lungs and was localized chiefly in the posterior portions of the middle and upper parts of the lungs. Whether the fluid was instilled into the right or the left naris was found to be unimportant as regards the localization of the fluid in the lungs, but the position of the animal was important. Thus, if the animal was on its right side, the major portion of the fluid entered the right lung, and if on its left side, the opposite lung. They found that the fluid readily entered the lower

12. Mullin, W. V., and Ryder, C. T.: Studies on the Lymph Drainage of the Accessory Nasal Sinuses, Laryngoscope **31**:158 (March) 1921. Mullin, W. V.: Tr. Am. Laryngol. Rhin. & Otol. Soc., 1919.

13. Corper, H. J., and Robin, H. A.: The Pulmonary Aspiration of Particulate Matter, Am. Rev. Tuberc. **6**:813 (Nov.) 1922.

lobes if the animal was held vertically, head extended (rabbit or dog), even though no anesthetic was administered. Observations similar to those mentioned resulted from instillations of india ink into anesthetized dogs.

Previous to using anesthetized animals, ten rabbits in the horizontal position with the head up were given nasal instillations of india ink. At postmortem examination of the lungs the observations were uniformly negative.

The experiments mentioned, they believed, indicate that liquids containing particulate matter in suspension (india ink), when aspirated into the lung from the upper air passages, reach an intrapulmonary localization dependent on the posture of the animal at the time. Liquids have a tendency to be aspirated immediately into the finest pulmonary divisions. In their discussion, the authors made this interesting statement:

> Although under certain circumstances there is easy access for fluids from the upper to the lower respiratory tract, as, for instance, in an animal like the rabbit, accustomed to the horizontal posture but placed in the upright position, there must be a more efficient protection for those naturally living in the upright posture or it would seem that respiratory infection as a result of upper respiratory tract contamination would exterminate or abolish the upright type. Under anesthesia, however, the ready access of fluid to the lungs from the upper respiratory tract in the horizontal posture would serve as a warning, as far as possible, by proper consideration for gravity conditions, to avoid such postures during anesthesia as would tend to facilitate the easy access of fluids from the upper to the lower respiratory tract.

Recently, the following experiment was carried out in an attempt to prove that aspiration from the upper respiratory tract does occur while a person is asleep. A small catheter, about 4 inches (10.16 cm.) in length, was placed in one nostril. Care was taken that the tip of the catheter did not enter the pharynx. The catheter was held in position by adhesive tape attached to the nose and face. During the night, between 11 p. m. and 5 a. m. at irregular intervals, from 1 to 2 cc. of iodized oil was gently put into the catheter with a syringe, until 20 cc. had been administered. As the patient awakened on the first few attempts ⅛ grain (0.008 Gm.) of morphine was given hypodermically and an hour later 10 grains (0.65 Gm.) of sodium barbital was given by mouth. At 8 a. m. a roentgenogram was taken and iodized oil was found in small quantities in both lower lobe bronchi. After one week the iodized oil had disappeared, as shown by roentgen examination, and the experiment was repeated without the administration of sedatives. This time the patient was less apprehensive, as he knew what to expect; consequently he slept well. The major portion of 20 cc. was aspirated into the right lung (fig. 1); in fact, so much was aspirated into the parenchyma of the lung that we feared it might be harmful. No unto-

ward effects, however, were noted by the patient, and subsequent roentgenograms have shown that the oil had in the main disappeared from the lung field. No attempt had been made to have the patient lie in any but his usual sleeping posture, with one pillow, in either experiment.

The second patient, J. R., also a man, on the first attempt under the same conditions of intranasal catheterization without relation to sleep-

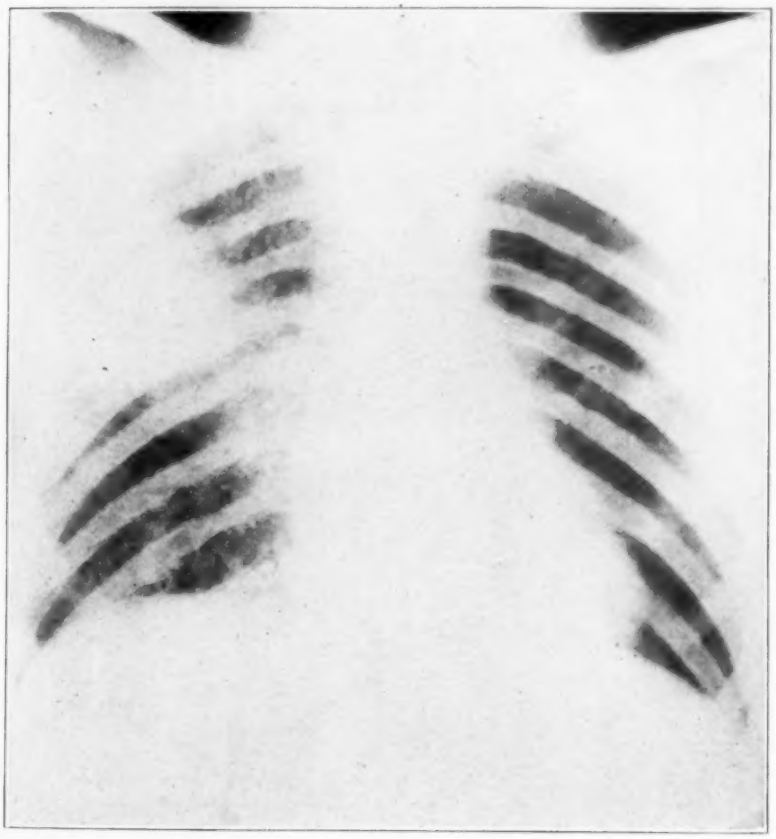


Fig. 1.—The right lung after the aspiration of iodized oil—20 cc. administered.

ing posture, aspirated small amounts of iodized oil into both lower lobe bronchi, as shown by the roentgen rays.

Then it was attempted to have six other persons (one female and five males) aspirate iodized oil in the same manner. Two of these were patients with bronchiectasis with sinusitis. None aspirated any iodized oil, but we are certain that at least four of these awakened every time an injection of iodized oil was attempted, and the other two slept poorly.

The oil has a disagreeable taste and on awakening the patients immediately swallowed or coughed and expectorated the oil.

In the meantime, as repeated injection with a syringe into the catheter, which extended only 1 or 2 inches (0.5 or 0.9 cm.) beyond the nose, was found to be disturbing, we substituted a larger catheter, size 16 F., and connected this to a buret which was attached to a stand at the side of the bed at a level high enough to permit a slow flow of oil whenever the stopcock was opened. The connection between the

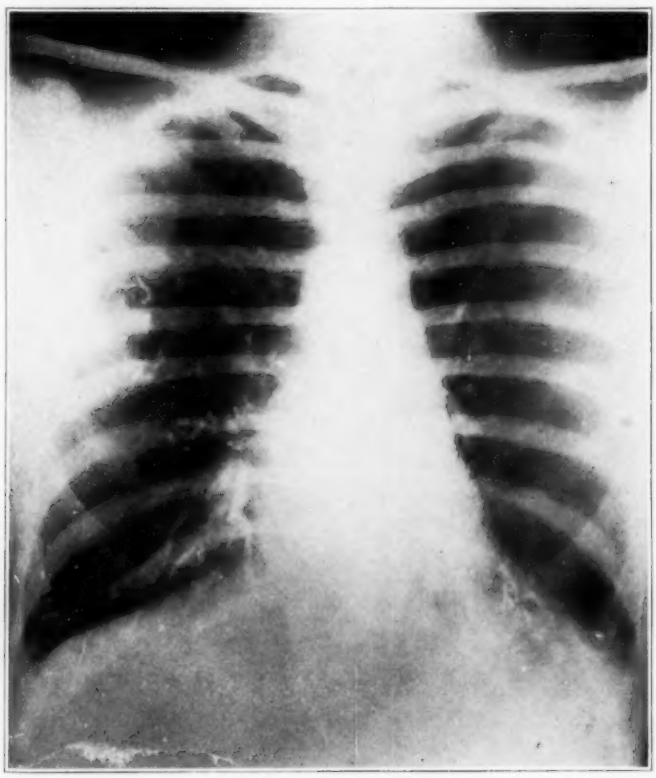


Fig. 2.—Both lungs after the aspiration of iodized oil—20 cc. administered.

buret and the catheter was long enough to permit its remaining in place all night regardless of the patient's position.

The next patient, A. S., was a young woman, aged 18, with bilateral bronchiectasis and pansinusitis. On the first attempt, without the administration of a sedative, the patient aspirated a considerable quantity of the 20 cc. of iodized oil into both lungs (fig. 2).

The next subject, T. J., had been at the hospital repeatedly for treatment of bronchiectasis of the lower lobe of the left lung.

Repeated attempts had been made to administer iodized oil as a therapeutic measure by the usual methods after cocainization of the pharynx. None of these attempts had been successful. This patient was given ⅙ grain (0.01 Gm.) of morphine and told to lie on the left side. When he was sound asleep and on the left side, the head and shoulders somewhat elevated by cranking up the head of the bed, the total quantity of iodized oil was allowed to run out of the buret into the

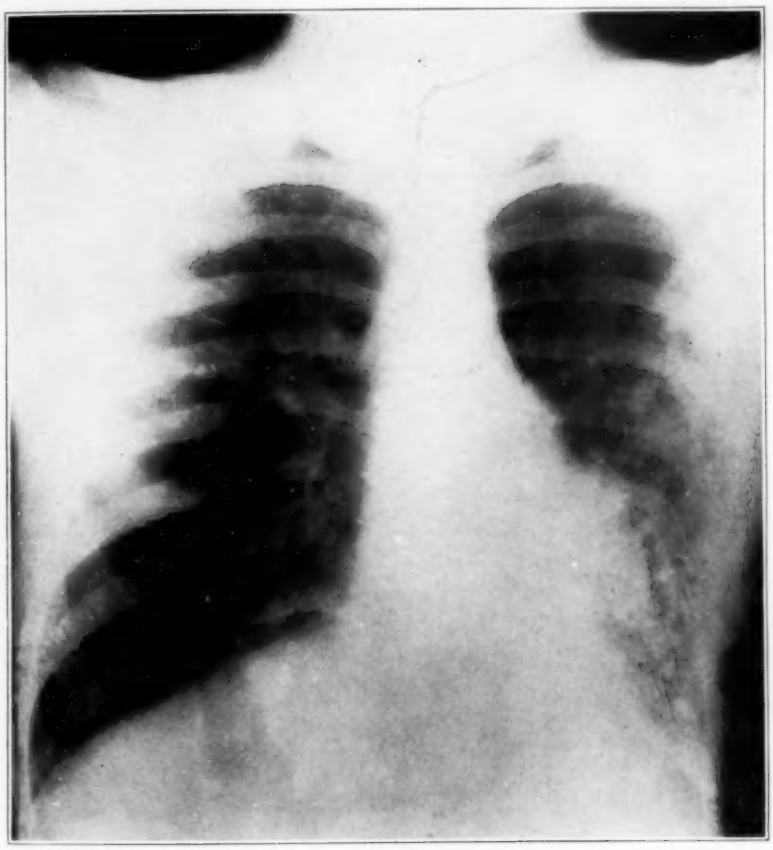


Fig. 3.—The left lung after the aspiration of iodized oil—20 cc. administered.

naris during a period of from ten to fifteen minutes. A considerable quantity was aspirated into the desired location (fig. 3). The same procedure was repeated seven days later with equally good results.

Another patient, a woman, aged 32, with bilateral bronchiectasis and pansinusitis, who had previously been filled with much difficulty by the usual methods, was also satisfactorily treated in the manner described.

SUMMARY

To summarize, the aspiration of iodized oil, when introduced into the nasal fossae by catheter, occurred in five of eleven persons while sleeping, and repeatedly in two of the five.

One must, of course, turn to anatomy and physiology to explain why this aspiration of fluid substances occurs during sleep with such surprising ease. According to Starling,[14] the arytenoid cartilages rest against the posterior pharyngeal wall except during the act of swallowing. Macleod[15] stated that there is a normal tonicity of the upper esophageal orifice. When the normal swallowing act takes place, the bolus causes stimulation of sensory nerve fibers to the fauces and pharynx. This initiates a series of complex movements: (1) inhibition of the respiratory muscles, (2) inhibition of the constrictor fibers of the esophagus, (3) elevation of the palate, (4) elevation of the root of the tongue and (5) elevation and drawing forward of the larynx. During sleep this swallowing reflex is apparently depressed sufficiently, at least in some persons, so that fluids may be aspirated into the lung.

It is a well known fact that the ostium of the antrum is a slitlike opening into the middle meatus about 2.5 cm. above the floor of the nose near the superior wall of the sinus and much nearer the posterior than the anterior wall. Drainage of the maxillary sinus, when the person is in the upright position, is possible only when there is overflow. When the person is recumbent on the side, however, ideal conditions for drainage of the antrum on the opposite side exist, and when recumbent on the back, drainage of both antrums is favored. It will be recalled that a large majority (90.9 per cent) of the patients with sinusitis and bronchiectasis whose cases are here reported had maxillary sinusitis with frank pus, alone or associated with involvement of some or all of the other sinuses.

CONCLUSIONS

1. Twenty-two of thirty-eight patients with bronchiectasis, or 57.9 per cent, were found to have coexistent sinusitis.

2. As a class, the patients with sinusitis were considerably younger than those without.

3. The majority of these patients had no symptoms of sinusitis.

4. From this series, no relationship between the degree of sinusitis and the degree of bronchiectasis could be established.

5. Aspiration of iodized oil into the lung from the nasal fossae while one is asleep is possible and does occur with apparent ease, and not infrequently the quantity aspirated is surprisingly large.

---

14. Starling: Principles of Human Physiology, Philadelphia, Lea & Febiger, 1912, p. 760.

15. Macleod: Physiology and Biochemistry in Medicine, St. Louis, C. V. Mosby Company, 1922, p. 480.

6. Aspiration of an oily fluid from the nose is so easy that it seems logical to assume that aspiration of infective material, as pus, might also be simple. In view of this circumstance, it is felt that aspiration is probably the most important explanatory factor for the frequent concomitance of bronchiectasis and sinusitis.

7. Filling of the bronchi by the intranasal route might be offered as a method when difficulty is found in filling by the usual methods or when bronchoscopy is undesirable.

RADIUM THERAPY IN ATROPHIC RHINITIS WITH OFFENSIVE ODOR (OZENA) *

LOUIS HUBERT, M.D.
Assistant Surgeon, Manhattan Eye, Ear and Throat Hospital
AND
G. ALLEN ROBINSON, M.D.
Director, Radium Department, Manhattan Eye, Ear and Throat Hospital
NEW YORK

In spite of a large number of researches and publications, rhinologists have not yet come to a definite agreement as to the etiology of ozena. Numerous theories have been advanced without, however, any one of them being adequate to explain all cases. One thing seems to be certain, i.e., ozena has become rarer since the almost routine removal of tonsils and adenoids and the better attention given to suppurating sinusitis. Even in large clinics, one is struck by the scarcity of this once fairly frequent disease.

The most characteristic symptom of ozena is the offensive, penetrating and nauseating odor, not perceived by the patient on account of the anosmia that is usually present. Even the cause of the production of the fetor is not quite clear. Bacteriology is not able to settle this question. It is difficult to determine whether the bacteria are the direct cause of the atrophy or only secondary invaders and the cause of the offensive odor. According to Frese,[1] the fetor is produced by a number of bacteria that are associated with protein putrefaction; he demonstrated the products of protein putrefaction in crusts from patients with this disease: skatol, phenol, indol, hydrogen sulphide and volatile fatty acids. Frankel and Schoenemann [2] express the belief that the growth of these putrefaction-producing bacteria is favored by the absence of the glands of Bowman, which are destroyed in the atrophic process of this disease. Krause [3] thought that the foul odor in ozena is caused by the fatty degeneration of the glandular cells of the nasal mucous membrane.

---

* Submitted for publication, June 4, 1929.

* Read before the Section of Rhinology and Laryngology, New York Academy of Medicine, April 24, 1929.

1. Frese, Otto: Untersuchungen ueber Enstehung und Wesen des Foetors bei der Ozaena, Deutsches Arch. f. klin. Med. **86**:169, 1905.

2. Fraenkel, E., and Schoenemann, in Denker, A., and Kahler, O.: Handbuch der Hals-, Nasen-, und Ohrenheilkunde, Berlin, Julius Springer, 1926, vol. 2, p. 624.

3. Krause, H., in Denker and Kahler: Handbuch der Hals-, Nasen-, und Ohrenheilkunde, Berlin, Julius Springer, 1926, vol. 2, p. 624.

However, other investigators have found the same degeneration in inflammatory processes of the nose without offensive odor. Whatever the real cause of this fetor is, it is the symptom that makes the patients miserable, causes them mental depression as they realize that they are shunned by society and forces them to seek medical aid.

TREATMENT

Up to the present, the treatment for true ozena has been unsatisfactory. All the physician could do was to assure the patients that whatever treatment used, if kept up indefinitely, would render them tolerable to their fellows, and that this disease has a tendency to disappear after middle life. It is difficult to account for this disappearance after middle life. It is probable that the fibrosis of the nasal mucous membrane in old age has something to do with it. This phenomenon gave us a clue to a new treatment. We thought that by the use of radium we could hasten the course of the disease, abolish the foul odor and leave the structural atrophy.

TECHNIC

As we had no knowledge of radium having been used in ozena before, the treatment was empiric. The earlier applications were made in the form of one half erythema doses, gamma radiation being used. Twenty milligrams of radium screened with 0.2 mm. of platinum and encased in a brass tube with a wall thickness of 1 mm. was applied to the lateral wall of each side of the nose for ninety minutes. Subsequently, an erythema dose was given, two 50 mg. radium tubes screened as already indicated being applied for one hour to each side of the nose. Within a week after the treatment, an inflammatory reaction was observed similar to acute rhinitis. After two or three weeks the reaction would subside, leaving the mucous membrane more healthy with a marked decrease in scab formation and with a corresponding diminution of the fetor.

REPORT OF CASES

In order to avoid repetition in the history of each case, we wish to emphasize that the cases reported here are typical ones of atrophic rhinitis with characteristic foul odor. Cases of sinusitis with bad odor, which disappeared after operation on the sinuses, are not included.

CASE 1.—T. C., a girl, aged 18 years, born in Austria, came to the Manhattan Eye, Ear and Throat Hospital, the clinic of Dr. McCullagh, on Nov. 10, 1923, complaining of a foul odor from the nose which had been present as long as she could remember. There was no history of syphilis, tuberculosis, injury or operation. The nasal sinuses appeared to be clear. The usual treatment for ozena was unsatisfactory. One day she complained bitterly that she could not meet any

friends on account of the foul odor, and that even members of her own family were complaining of the fetor. We suggested radium therapy. The first treatment was given on Jan. 8, 1924. Altogether, she received five treatments, a total dosage of 277.5 mg. hours. The foul odor gradually disappeared; the crusts were diminished in quantity and could be removed with greater facility.

On Feb. 5, 1925, no odor was perceptible; there were some dryness and little scab formation on the nasal mucous membrane, but the patient felt happy and was married.

Case 2.—M. W., a girl, aged 18 years, born in the United States, came to the hospital on Oct. 29, 1927, complaining of a foul odor and formation of crusts which had been present since birth. There was no history of syphilis, tuberculosis or injury. She had a mild hyperthyroidism, with some enlargement of the thyroid gland, a pulse rate of 114 and a fine tremor of the tongue and the outstretched fingers. As the nasal antrums were diseased, a double intranasal operation on the antrums was done. The foul odor persisted. She then received seven radium treatments, a total dosage of 910 mg. hours. The foul odor disappeared; there was less scab formation, and a general improvement in health and well-being. She also married.

Case 3.—T. C., a girl, aged 19 years, born in the United States, came to the hospital on Jan. 6, 1924, complaining of a foul odor that had been present for one year. There was no history of syphilis, tuberculosis, injury or operation. The nasal sinuses were apparently clear. The first radium treatment was given on January 17. There was an improvement after the first treatment, but the patient did not return for further therapy until April 13, 1925. At that time, the foul odor had returned. She then received five more radium treatments, a total dosage of 428 mg. hours. Her condition was improved. A slight odor and slight scab formation were still present.

Case 4.—H. M., a girl, aged 16 years, born in the United States, came to the hospital on June 20, 1927, complaining that she had been unsuccessfully treated for ozena, including operations on the nasal sinuses, for the last five years. There was no history of syphilis, tuberculosis or injury. After two radium treatments, a total dosage of 400 mg. hours, the bad odor disappeared. When she was last seen on March 14, 1929, there was no odor from the nose, and only slight crust formation.

Case 5.—J. G., a boy, aged 19 years, born in Italy, came to the hospital on Dec. 4, 1928, complaining of a foul odor from the nose which had been present for the last five years. There was no history of syphilis, tuberculosis, injury or operation. The nasal sinuses were apparently not diseased. He was given three radium treatments, a total dosage of 650 mg. hours. The foul odor was first diminished in intensity, and then disappeared. There was only slight crust formation.

REVIEW OF LITERATURE AND COMMENT

When we started this novel treatment for ozena, we were unaware that it had ever been used by anyone else. In preparing this paper and searching through the literature, we found that Dionisio,[4] an Italian, was probably the first to think of radium as a possible treatment for ozena, but he did not state that he ever used it. He treated

4. Dionisio, I.: La radiation dans le traitement de l'ozène, Rev. hebd. de laryngol. **1**:449, 1904.

patients with this disease by means of radiations from a modified Finsen lamp. In 1925, Vasilia [5] reported four cases of ozena in which a complete cure was effected by radium. His results were so marvelous that he concluded that radium therapy is the only means of treating patients who have this horrible disease. He used a small amount of radium, from 0.3 to 0.7 mg. for from six to eight hours, believing that these minute doses have a stimulating effect on the atrophic nasal mucous membrane. In the same year, Yoel [6] described an advanced case of ozena in which radium effected a cure, the same method as that of Vasilia being used.

In 1927, Carrari [7] reported eight cases of ozena in which radium treatment was used. He did not have at his disposal such a small amount of radium as that used by Vasilia and Yoel, so he employed 2.87 mg. for only fifty or sixty minutes. His results were not quite satisfactory, and he objected to the term cure used by the foregoing authors. In his cases he observed a softening of the crusts, so that they could be removed with greater facility; that the foul odor was somewhat diminished but not abolished; that the mucous membrane was less pale but still atrophic, and that there was a transitory return of the sense of smell for acute odors. He did not think that radium has a greater value than other means at the otolaryngologist's disposal. However, in reading his case reports we notice that he did not investigate the condition of the nasal sinuses. We do not believe that a foul odor caused by sinusitis can be favorably influenced by radium. His conclusions, therefore, are open to criticism. We agree with Carrari that it is preposterous to talk of a cure for ozena. We do not think that radium acts as a stimulant to the atrophic nasal mucous membrane and brings about a restoration of normal epithelial cells, as claimed by Vasilia and Yoel, but we do believe that the favorable results obtained by this treatment are produced by a fibrosis of the submucosa, which in some way interferes with the formation of the foul secretions. We also wish to emphasize that in studying these cases we must ask ourselves whether there is evidence of a suppurating sinusitis and whether the foul odor is not due to the diseased sinuses, especially the antrum and the sphenoid. Operation on these sinuses will settle this question. It is possible to have a true ozena plus suppuration of a sinus. Operation on the sinuses will not remove the foul odor. We believe that radium therapy in such cases deserves a fair trial.

---

5. Vasilia, I.: La guérison de l'ozène par le radium, Arch. internat. de laryngol. otol. rhinol. **31**:257, 1925.

6. Yoel, M.: La guérison de l'ozène par le radium, Arch. internat. de laryngol. otol. rhinol. **31**:1077, 1925.

7. Carrari, G. G.: Sulla radium-terapia dell'ozena, Valsalva **3**:77, 1927

SUMMARY

We have used radium treatment in five cases of ozena, and the results have been satisfactory. We do not claim to have cured the patients, but we believe that this treatment, used by one who knows its dangers and limitations, is a valuable aid in attacking the most obnoxious feature of the disease, namely, the foul odor. In four cases the foul odor disappeared, and in one case it was much diminished.

In all the cases, the crusts became much less in quantity and softer, so that they could be removed with greater facility. We believe that, if the cases are carefully studied, and syphilis and suppurating sinusitis excluded, radium has a new field of usefulness in a disease that up to the present time has completely baffled otolaryngologists.

161 East Seventy-Ninth Street.

120 East Seventy-Fifth Street.

ACUTE INFECTIOUS MONONUCLEOSIS

FROM THE POINT OF VIEW OF AN OTOLARYNGOLOGIST *

WILLIAM O. LaMOTTE, M.D.

WILMINGTON, DEL.

The disease which is the subject of this paper is of interest to the otolaryngologist as well as to the internist, from both the practical and the theoretical standpoint. Previous to 1920, following E. Pfeiffer's [1] description in 1889 of a condition in children which he called Drüsenfieber, cases of fever lasting from nine to twenty-seven days, accompanied by enlargement of the lymph nodes and called glandular fever, were described in the literature. Tidy and Morley [2] regarded this condition as identical with acute infectious mononucleosis, but there is no proof that this is true. Before 1920, when Spruant and Evans [3] first described the disease as a clinical entity, there had been no study reported of the blood picture. In 1922 Longcope [4] reported ten cases, and in 1927 Cottrell reported twelve cases. In Longcope's series the first recorded case he saw was in 1909, the second in 1915. In Cottrell's [5] series, the first case and the earliest discoverable in the records of the University Hospital was in 1921; his second case was in 1924. It would seem, therefore, that this disease is comparatively rare. There have been reports of cases resembling infectious mononucleosis which were considered by the authors as acute leukemia with recovery (Cabot,[6] Hall,[7] Jackson and Smith,[8] Ludke,[9] Marchand,[10] Turck [11]). The disease has also been mistaken for tuberculosis, typhoid fever and Hodgkin's disease. The absolute increase in mononuclear cells in infections such as typhoid, pertussis, malaria, malta fever and possibly tuberculosis is not great as compared with the increase in infectious mononucleosis.

---

* Submitted for publication, May 2, 1929.

* Read by invitation at the College of Physicians of Philadelphia, Section on General Medicine, Nov. 22, 1928.

1. Pfeiffer, E.: Jahrb. f. Kinderh. **24**:257, 1889.

2. Tidy, H. L., and Morley, E. B.: Brit. M. J. **1**:452, 1921.

3. Spruant, T. P., and Evans, F. A.: Bull. Johns Hopkins Hosp. **31**:410, 1920.

4. Longcope, W. T.: Am. J. M. Sc. **164**:781, 1922.

5. Cottrell, J. E.: Am. J. M. Sc. **173**:472, 1927.

6. Cabot, R. C.: Am. J. M. Sc. **145**:335, 1913.

7. Hall, A. J.: Proc. Roy. Soc. Med. **8**:15, 1914-1915.

8. Jackson and Smith: Boston M. & S. J. **172**:136, 1915.

9. Ludke: Deutsches Arch. f. klin. Med. **100**:100, 1910.

10. Marchand: Arch. f. klin. Med. **110**:359, 1913.

11. Turck, W. M.: Wien. klin. Wchnschr. **20**:157, 1907.

REPORT OF CASES

CASE 1.—The patient in this case was younger than any in the cases reported. In Longcope's series of ten patients, the ages ranged between 12 and 30 years. In Cottrell's series of twelve patients, the ages were between 18 and 26 years.

History.—A white boy, aged 5½ years, was brought to me on July 18, 1927, principally because he had a rise in temperature between 98 and 102 F. or more, with enlargement of the cervical glands, of four months' duration. There was a history of measles just preceding the glandular involvement. There was no other child in the family, except a brother who died at the age of 9 months of some respiratory condition. There is no other history of any importance except that the father came to me on July 16, 1927 (two days before the boy was seen), with a history of hoarseness for seven weeks, following peritonsillar abscess on the right side. There was adductor paralysis of the right vocal cord. He had a tonsillectomy at the age of 10, or twenty-one years ago, but there were embedded, adherent stumps, which gave a culture of staphylococci and *Micrococcus catarrhalis.* The sputum showed only streptococci. Other examinations, including those of the blood and the chest, showed nothing abnormal. I removed the stumps on July 21, using procaine hydrochloride anesthesia, and in about one month the paralysis had disappeared.

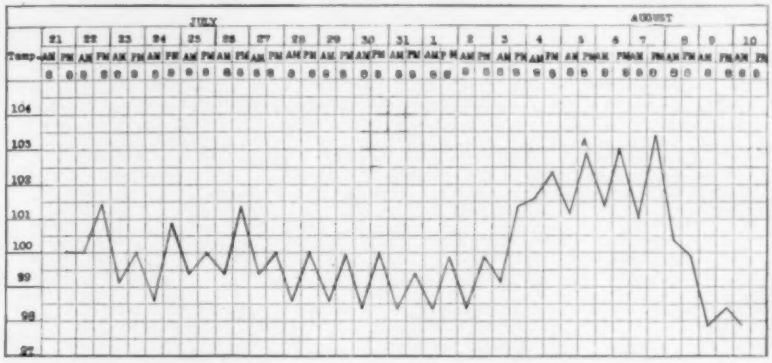
Examination.—Both anterior and posterior chains of the cervical glands were palpable, and some were visibly enlarged. The axillary and inguinal glands were palpable. The tonsils were red, large and somewhat embedded; the crypts were deep and appeared to be infected. A culture from the tonsils showed a pure culture of staphylococci. The urine was normal. The blood showed: hemoglobin content, 80; red blood cells, 4,220,000; white blood cells, 14,500; polymorphonuclears, 25 per cent; small mononuclears, 70 per cent; large mononuclears, 2 per cent; transitionals, 1 per cent, and eosinophils, 2 per cent. The eyegrounds were normal. A roentgen examination of the chest showed everything normal except for a slight enlargement of the thymus. Neither the liver nor the spleen was palpable. An examination of the blood for malaria gave negative results. Both the Widal and the Pirquet tests were negative. While a lymphocyte count of 50 per cent or more up to the age of 6 is considered normal, I was at a loss to account for the blood picture; because of the enlarged thymus, the culture from the tonsils and the other conditions, I had Dr. Louis Parsons make an examination and advise whether or not he thought the tonsils should be removed. He advised removal, and on July 21 the tonsils were enucleated. Before the operation the temperature was 99 F., the pulse rate, 104, and respiration, 24. The temperature continued between 98.2 and 101.4 F., and on July 27, Dr. Joseph Sailer of Philadelphia examined the patient. Dr. Sailer found no enlargement of the liver or spleen. He thought, of course, of tuberculous lymphadenitis and acute leukemia, but rather thought it was a case of acute mononucleosis. On August 5, grayish patches occurred in the tonsillar fossae, the mucous membrane of mouth and throat were very red and the gums were swollen, resembling the condition in a typical case of Vincent's angina. On two occasions, however, smears showed no Vincent's organisms. At this time the temperature rose from around 100 to 103.2 F., fluctuating between 101 and 103.4 F. until August 8, when suddenly it fell to about 100 F., and on the ninth became normal and remained so, coming down almost by crisis.

A letter from the father on December 22 said: "The enclosed blood test I believe is almost normal. He has put on lots of weight. As I remember he weighed 44 pounds (20 Kg.) when we left Wilmington. Now he is up to 58

(26.3 Kg.). He has not had a real sick day since he came back. One thing I notice especially is that he seems able to throw off a cold very easily. It used to be that if he once started with a cold it was a matter of at least two weeks —in bed—fever—etc., before he could shake it. Now they never really develop."

An oxidase reaction showed the protoplasm of the abnormal cells to be free of granules.

CASE 2.—A white boy, aged 13, was referred by Dr. Walter Ellis of Delaware City on Oct. 1, 1927. Since an attack of the grip three weeks previously, he had been feeling languid, and one week before examination enlargement of the sub-



Temperature chart for case 1. *A* represents the appearance of the faucial exudate.

TABLE 1 (CASE 1).—*Hematology*

Date	Hemoglobin Content	Red Blood Cells	White Blood Cells	Polymorphonuclears	Large Mononuclears	Small Mononuclears	Eosinophils	Transitionals
7/20/27	80	4,220,000	14,500	25	2	70	2	1
7/23/27	75	3,950,000	8,800	44	2	52	0	2
7/26/27	..	4,220,000	12,600	44	2	52	..	2
7/27/27	78	4,150,000	9,300	44	2	50	2	2
7/29/27	78	4,110,000	8,200	43	3	51	2	1
8/ 4/27	80	4,150,000	7,000	10	8	80	1	1
10/ 3/27	75	4,000,000	7,500	52	8	40		
12/17/27	70	3,500,000	6,300	60	31	9	(from Orange, N.J.)	

occipital and postcervical glands was observed. He was a large boy and was well nourished. The temperature was 100.6 F., the pulse rate, 102. The anterior and posterior cervical glands were enlarged. The axillary and inguinal glands were enlarged. The tonsils were large and ragged, and considerable amounts of cheesy material were present in the crypts. The gums and ears were normal. No Vincent's organisms were present. A culture from the tonsils showed staphylococci, streptococci and *Micrococcus catarrhalis*. The Wassermann reaction was negative. The urine was normal. Neither the liver nor the spleen was palpable. On November 3, the tonsils and adenoids were removed. The tonsils were very much bound down by adhesions. On December 30, the glands in the neck were still palpable but much reduced.

CASE 3.—A white girl, aged 19, a patient of Dr. John H. Mullin, had been in bed for four days with fever and tonsillitis. Dr. Mullin asked me to see the patient on Jan. 9, 1928, because he was ill. The family had reported an enlargement behind the left ear.

At 6 p. m., the temperature was 102 F. There was a bilateral enlargement of the anterior and posterior cervical glands. In the right anterior triangle there was a large mass of glands (the patient said that the glands here had been large since Christmas). The enlargement behind the left ear consisted of two visible, tender, posterior auricular glands. Both drums were somewhat retracted; the left was pink. The tonsils were large, and the crypts were full of grayish and greenish material. A smear showed no diphtheria bacilli or Vincent's organisms. I saw the patient two days later and found sloughing of the tonsils, and the dirty-looking, greenish material on them and the red gums resembled a typical case of Vincent's angina, but a second smear showed no such organisms. The glands of the axillae and the groins were found to be bilaterally enlarged. There was no

TABLE 2 (CASE 2).—*Hematology*

Date	Hemoglobin Content	Red Blood Cells	White Blood Cells	Polymorphonuclears	Large Mononuclears	Small Mononuclears	Eosinophils	Transitionals
10/ 5/27	84	4,350,000	8,600	30	5	64	..	1
10/13/27	..	.....	9,500	33	10	51	3	3
11/ 3/27	..	.....	10,000	42	9	45	3	1
12/30/27	..	.....	8,500	53	7	36	4	2

TABLE 3 (CASE 3).—*Hematology*

Date	Hemoglobin Content	Red Blood Cells	White Blood Cells	Polymorphonuclears	Large Mononuclears	Small Mononuclears	Eosinophils	Transitionals
1/12/28	81	4,150,000	12,000	20	27	50	0	2
		Red cells normal						
2/ 3/28	80	4,150,000	10,200	46	7	44	1	2

enlargement of the liver or spleen (this was corroborated later by Dr. Mullin). The patient was at her home in the country, which accounted for the delayed blood report.

SUMMARY

One of the cases was from south of Wilmington, one from west of Wilmington and one from New York.

The patient in case 1 is the youngest on record. Longcope's patients were between the ages of 12 and 30, Cottrell's between 18 and 26. Longcope's patients consisted of two females and eight males, and Cottrell's, eleven males and one female, which he said is about the same ratio in other reported series.

In the first of my cases the tonsils were not acutely involved but were embedded and apparently unhealthy, in the second they were large and unhealthy and in the third they were extensively involved. Longcope stated, "in three cases the tonsils were swollen, red and

acutely inflamed. In two other cases in which the tonsils had been previously removed the lymphoid tissue of the pharynx was swollen and the pharynx was red. In one case the pharynx alone was red, and in one instance the disease came on after tonsillectomy." The description, however, of the tonsillar fossae is not as instructive as in Cottrell's series. In case 9, in which the patient was admitted to the hospital in May, 1909, he said "The tonsils were not seen." The patient had had a tonsillectomy two years before. In January, 1920, "he had a suppurating abscess of the left tonsillar fossa from which creamy pus was evacuated," indicating that a piece of tonsil had remained. Cottrell reported: "In seven cases there was actual ulceration or exudation on the tonsils or pharyngeal wall; all but one of the others showed congestion of the fauces and pharynx in varying degrees, and that one was not seen by us during the height of the disease." In six of the seven cases showing ulceration or exudation, that is, in six of his twelve cases, smears from the tonsils were positive for the spirillae and fusiform bacilli of Vincent, and he thought that this observation may have some bearing on the disease. Longcope reported, however, that smears from the tonsils and pharynx of three of his cases showed spirillae and fusiform bacilli in small numbers. Cottrell found the spleen enlarged in nine of his cases, without enlargement of the liver. Longcope found an enlarged spleen in eight of his ten cases, with one case of palpable liver. In all instances the lymph nodes were enlarged.

Tidy and Daniel,[12] in speaking of glandular fever, said: "A tonsil may be enlarged but the presence of exudation is unusual and the changes are characteristically slight compared with the marked glandular enlargement." In reporting on the blood in an epidemic of glandular fever in a school, in twenty-one cases they found that the mononuclears did not exceed 52 per cent in four cases, and usually were less than 50. Their cases were probably glandular fever. It would seem that the acute mononucleosis is an entity. It is so regarded by Longcope, Cottrell and others. At any rate, the term has the virtue of calling particular attention to the blood picture. It can thus be differentiated from acute leukemia and the family can be assured of its favorable prognosis.

The cause of the disease is unknown. Rosenow[13] found that aerobic cultures from pulp of a tooth remained sterile, while partial tension cultures in tubes of dextrose blood broth yielded an anaerobic streptococcus which produced iritis in a series of rabbits. Thus, if aerobic cultures only were made the teeth would have been pronounced sterile. Might it not be possible that some such organism in the tonsil

12. Tidy, H. L., and Daniel, E. C.: Lancet **2**:9, 1923.
13. Rosenow, E. C.: Ann. Otol. Rhin. & Laryng. **36**:883, 1927.

could be the cause of acute mononucleosis? This belongs perhaps more in the province of the bacteriologist or the internist. These cases were all seen by me as an otolaryngologist, and it may be that through the otolaryngologist more cases will be recognized and a deeper study will be made than in the cases here reported, thus contributing, perhaps, to the sum total of knowledge of this interesting disease.

Medical Arts Building.

CALCULUS OF THE SUBMAXILLARY GLAND AND DUCT *

FRED E. HAMLIN, M.D., M.Sc. (MEDICAL)
ROANOKE, VA.

Calculus of the submaxillary gland and duct was first mentioned in the literature of the seventeenth century. Little has been written in textbooks on this subject. The condition is never responsible for death, which naturally causes it to occupy a humble place in surgery.

The infrequency with which submaxillary calculi appear, the importance of the clinical symptoms and the difficulties experienced in making a correct diagnosis induce me to select this subject. The necessity of making a correct diagnosis of submaxillary calculi is of extreme clinical importance in order to prevent needless treatment. This may be medical or surgical.

Before I describe the various conditions manifested by pain and swelling in the floor of the mouth and in the submaxillary triangle, it may not be untimely to review briefly the anatomy and physiology of this important structure.

SURGICAL ANATOMY

The submaxillary gland lies in the submaxillary triangle, adapting its form apparently to the shape of the space in which it lies. It is triangular, with its long axis parallel with the axis of the ramus of the mandible. The submaxillary triangle is bounded above by the lower border of the mandible and a line drawn from the angle of the mandible to the tip of the mastoid process; below, by the posterior belly of the digastric muscle and the stylohyoid muscle; in front, by the anterior belly of the digastric muscle. Covering this triangle are the skin, superficial fascia, platysma muscle and deep cervical fascia in which are found several branches of the facial and superficial cervical nerves. The floor of the submaxillary triangle is formed chiefly by the mylohyoid muscle which separates it from the floor of the mouth. Beneath the platysma muscle are found the submaxillary and submental lymph nodes into which drain the lymphatics from the floor of the mouth, gums and tongue. Posterior to these, just beneath the angle of the jaw and anterior to the sternomastoid muscle, are the deep cervical nodes into which drain the fauces and tonsils; beneath the deep fascia is the submaxillary salivary gland which

* Submitted for publication, June 4, 1929.

* Candidate's Thesis for the Degree of Master of Medical Science in Otolaryngology, Graduate School of Medicine, University of Pennsylvania, Philadelphia.

rides astride the posterior border of the mylohyoid muscle, dividing the gland into a cervical and buccal, or deep and superficial, portion. The cervical occupies the submaxillary triangle of the neck, and the buccal lies beneath the mucosa of the floor of the mouth. The cervical portion constitutes more than two thirds of the total gland. In some cases, the gland is distinctly divided and connected only by its duct.

The duct of Wharton emerges from the medial surface of the submaxillary gland, passes around the posterior border of the mylohyoid muscle, then runs forward and upward beneath the mucous membrane of the floor of the mouth and on the mylohyoid muscle. At first, it lies between the lingual nerve above and the hypoglossal below, reaching the surface of the genioglossus muscle; the lingual nerve crosses into the inner side. The duct passes to the inner side of the sublingual gland and opens on the floor of the mouth, having its outlet on the summit of a papilla beside the frenum of the tongue. The submaxillary duct varies between 4 and 5 cm. in length, and when it is traced backward it will be seen to divide at the hilum of the gland into three ducts which subdivide into 1,500 lobular ducts (Flint [1]).

Within the submaxillary triangle are found the external maxillary and lingual arteries, the anterior facial vein and branches of the facial nerve to the platysma and the hypoglossal and glossopharyngeal nerves. The external maxillary artery is given off from the external carotid, passes upward to the upper border of the submaxillary gland, then upward to the facial notch which is a depression that can be palpated about 2 cm. in front of the angle of the mandible. The submaxillary and submental branches of this artery are given off within the gland. The nerve supply of the gland is derived from the lingual, submaxillary ganglion and the sympathetic plexus on the external maxillary artery. Its blood supply is from the external maxillary artery. The facial veins are entwined about the gland forming the common facial vein at its inferior surface.

PHYSIOLOGY

Saliva is a clear, tasteless, slightly opalescent and normally alkaline fluid. Its function is protection of the oral cavity, aiding articulation by acting as a lubricant, assisting deglutition and the sense of taste by softening the food. The action of the ferment ptyalin aids digestion by changing starchy foods into dextrin and maltose. According to Widdowson,[2] the quantity of saliva secreted in twenty-four hours is estimated as being between 2 and 3 pints (946 and 1,419 cc.). Only one twentieth of this amount is secreted by the submaxillary gland.

---

1. Flint, J. M.: Am. J. Anat. **1**:269, 1901.

2. Widdowson, T. W.: Notes on Dental Pathology, New York, William Wood & Company, 1921.

Hill [3] stated that:

> The salivary secretion is produced by a nervous influence presided over by a centre in the medulla oblongata in the region of the glossopharyngeal nucleus. To this centre come impulses directly by various centre nerves, and also indirectly via the higher centres of the brain. Thus it is that contact of food with the buccal mucous membrane or stimulation of the central end of the lingual or glossopharyngeal nerve gives rise to a flow of saliva. Sight and hearing act reflexly through the high centres. The same holds true of past impressions such as are aroused by thinking of a favorite meal. This may make the mouth water, especially if in a state of hunger. In regard to the submaxillary gland it has been proved experimentally that if the lingual nerve be cut high up, reflex secretion of saliva still occurs, while on the other hand, if the chorda tympani nerve be cut, reflex secretion is abolished, though stimulation of the peripheral end causes a copious flow of watery saliva. The chorda tympani nerve issues from the seventh nerve as a small branch which, joining the lingual in the lower part of its course runs with it for a short distance and then passes to the glands.

It was once thought that Wharton's duct contained muscle fibers, but recent histologic examinations by Bailey,[4] and later by Case,[5] have shown the absence of musculature. The normal expulsion of saliva or spontaneous expulsion of a stone is produced by the pressure within the gland assisted by the muscles in the floor of the mouth. Hill [3] stated that submaxillary pressure may be proved by attaching a manometer to Wharton's duct during stimulation of the chorda tympani nerve, this pressure being found to rise to twice the height of the arterial blood pressure within the gland.

ETIOLOGY AND COMPOSITION

There exists a certain degree of indefiniteness as to the exact etiology of salivary calculi, shared alike in this respect with stones in other parts of the body—renal, biliary and pancreatic. The definition of salivary calculus is a deposition of the salts of the saliva; if deposited on the teeth it is called tartar, and if in the duct or gland it is called calculus. The probable causes are: (*a*) inflammation of the mucous membrane causing an increased precipitation of the salts of the saliva; (*b*) the deposition of salts around bacterial masses or inorganic particles, such as small pieces of grain, pieces of oyster shell, and fish bones which have been found within Wharton's duct by some observers.

According to the works of Waldeyer, Boas and Klebs, as quoted by Galippe,[6] the central kernel of the salivary calculus is composed of a mass of bacteria which they believe acts as a center of crystallization.

---

3. Hill, Leonard, in Flack and Hill: Textbook of Physiology, New York, Longmans, Green & Company, 1919, p. 375.

4. Bailey, Hamilton: Brit. J. Surg. **12**:321 (Oct.) 1924.

5. Case, E. A.: Unpublished work.

6. Galippe: Compt. rend. Soc. de biol. **3**:116, 1886.

The chemical analysis and bacteriologic examination of the tartar on the teeth show a composition almost identical with that of salivary calculi.

Magnesium and calcium phosphate, calcium fluoride and calcium carbonate with the chloride of sodium and potassium and a small amount of sulphocyanide of potassium form from 78 to 82 per cent of the make-up of the submaxillary calculus (Widdowson [2]). The remainder is made up of animal matter and bacteria.

FREQUENCY OF OCCURRENCE AND CLINICAL NOTES

Erdman [7] reported 300 cases of submaxillary calculi up to May, 1920, and since that time several cases have been reported by various writers. However, the condition is more common than these figures would lead one to believe, many cases not being reported. Of the salivary calculi, those of the submaxillary gland and duct will comprise 75 per cent. "Submaxillary calculi are not so numerous that one cannot remember the cases that he has seen in his own practice" (Bazy [8]).

Calculi have been found in patients between the ages of 9 and 65 years. They have been found to be three times more common in the male sex. According to the literature, the French have reported the greatest number of cases of submaxillary calculi.

SYMPTOMATOLOGY AND DIAGNOSIS

Pain.—When pain is produced by stasis or secondary infection, it is usually the symptom that cases the patient to consult a physician. It may be described as a sharp pain in the floor of the mouth radiating along the side of the tongue, more severe during mastication. This may be augmented even by the memory of a good meal or by the sight of food. Patients sometimes describe this as being similar to toothache. The severity of the pain, at times, is so great as to interfere with deglutition and phonation. Frequently patients will consult a dentist, thinking the pain is of dental origin.

The submaxillary duct, when obstructed by calculus or inflammatory product, causes an increase of pressure within the gland during the time of stimulation. This pain can be described as "salivary colic," first mentioned by the French writers, and is similar to the pain produced by biliary and renal calculi.

Swelling in the Submaxillary Triangle.—If a patient states that the swelling in the submaxillary area varies in size from time to time, reaching its maximum degree during mastication, one has a pathognomonic sign of obstruction, calculus being the most frequent cause. When

7. Erdman, Seward: Calculi in Salivary Ducts, J. A. M. A. **74**:1447 (May 22) 1920.

8. Bazy, M. P.: Bull. acad. de méd. Par. **90**:148, 1923.

unassociated with pain, a small swelling beneath the lower border of the mandible rarely causes a patient to seek advice.

The submaxillary gland may be enlarged and may contain a stone or a number of stones without giving any symptoms, as demonstrated in the following case: Maguire [9] reported a case of salivary calculus without symptoms and with spontaneous extrusion, weighing 45 grains (2.9 Gm.). There were no subjective or objective symptoms usually associated with calculi. The patient never had a feeling of discomfort after or during a meal.

Swelling in the floor of the mouth, associated with a hard mass in the submaxillary triangle giving rise to a spasmodic pain, more severe during mastication, is most important in the diagnosis of a calculus. By intra-oral and extra-oral palpation of the gland and duct, it is possible to outline the entire course if done in the following manner, as described by Bailey: [4]

> The patient's head is flexed and inclined slightly to the affected side in order to relax the musculature. The index finger is inserted into the mouth, the pulp of the finger being placed upon the internal alveolus. The finger is passed backward, following the alveolus until the extreme posterior extremity is reached. The finger (now insinuated between the alveolus just behind the last molar tooth and the side of the posterior third of the tongue) is rotated through a right angle, so that the pulp of the finger is directed downward. In conjunction with the fingers of the other hand beneath the jaw, the whole course of Wharton's duct is palpated from behind forward. In about one out of four patients, this maneuver brings on retching, but even in this event the valuable information required is elicited before any severe discomfort is experienced.

The calculus, if present, may be felt as a hard nodule somewhere along the course of the duct, unless considerable inflammation is present. Sometimes, as in spontaneous expulsion, the stone will be seen piercing the duct.

ROENTGEN EXAMINATION

Salivary calculi are rich in mineral salts, which makes it easy to obtain a good shadow on the roentgenogram in the majority of cases. Of course, the density of the stone varies according to the chemical composition, and sometimes a smaller calculus will weigh more than a larger one. Many errors have been made, and negative reports have been given out by roentgen technicians as a result of faulty technic. A calculus in the anterior two thirds of Wharton's duct can be easily demonstrated by using a no. 2 film, 2½ by 3¼ inches, placed horizontally between the teeth as far back in the mouth as possible and by directing the rays from beneath the chin upward (Ivy [10]). The calculus in the posterior third of the duct or in the gland itself will best be shown by

9. Maguire, George J.: Brit. M. J. **1**:825, 1901.

10. Ivy, R. H.: Ann. Surg. **73**:377, 1921.

taking the lateral view. The anterior two thirds of the duct cannot be demonstrated by a lateral picture because the shadow of the mandible will obscure the duct.

Patients with submaxillary calculi, as a rule, are not very sick unless a secondary infection is present. A swelling in the submaxillary triangle is regarded too lightly, unless it is large or produces symptoms that have been described in textbooks. During the rush of work in the clinic, one may prescribe some local treatment as a placebo without making a diagnosis, hoping the patient will not return.

REPORT OF CASES

Case 1 shows how a patient can go from one clinic to another without a diagnosis being made, and receiving treatment for a swelling underneath the angle of the left jaw.

CASE 1.—*History.*—Mrs. E. S., white, Bohemian, aged 44, was admitted to the Medico-Chirurgical Hospital, Oct. 29, 1924, on the service of Dr. George M. Coates, because of a painful swelling below the angle of the left jaw. The father died of tuberculosis at the age of 54; the mother died of pneumonia at the age of 53; one sister died of tuberculosis at the age of 11. The husband had had "blood trouble" for several years, but refused to take treatment. At the age of 6, the patient was blind and had to be treated by a specialist for six months before sight returned; the diagnosis was unknown. The patient gave a history of frequent attacks of tonsillitis since childhood, occasionally associated with quinsy. In February, 1924, while preparing the evening meal, she walked out in the yard and on returning to the kitchen was seized with a pain in the floor of the mouth radiating backward along the side of the tongue; within five minutes she noticed a swelling below the left jaw the size of a hen's egg. The swelling did not increase within the following twenty-four hours, but the pain became unbearable and a physician was consulted for relief of the pain. She was informed that she had mumps and was given a black salve to use locally several times a day, which made her feel more comfortable. The swelling and a continuous pain remained for a week, but after this the symptoms were noticed only during mastication, lasting for twenty minutes. Within three weeks, the exaggerated symptoms reappeared. In May, 1924, she went to one of the dispensaries in Philadelphia twice a week for four weeks but obtained little relief; she then entered another clinic which she attended twice a week for three weeks. The swelling at this time was about the size of an egg. A roentgenogram was made and a salve prescribed, but the patient was never informed as to the cause of the swelling. In September, 1924, she was admitted to another clinic, and her tonsils were removed. She was informed that the swelling was due to infected tonsils. The tonsillectomy had no effect on the swelling.

On October 29, she was admitted to the Medico-Chirurgical Hospital.

Examination.—On admission, examination revealed a swelling in the left submaxillary triangle about the size of a hen's egg which was well circumscribed, indurated and caused much pain on palpation. No particular pain was produced when the mouth was opened. When the floor of the mouth was palpated, a small nodular mass was felt in the anterior two thirds of Wharton's duct. All of the lower teeth were extracted several years before admission, and the patient wore a plate, the gums being in a good condition. There were no signs of inflammation

around the frenum of the tongue. The temperature was 99 F.; the pulse rate, 90 and respirations, 20. Urinalysis revealed: acid; specific gravity, 1.010; no sugar; albumin, a trace; many hyaline and a few granular casts.

The Wassermann reaction of the blood was strongly positive. Two roentgen examinations were made, and the following report was given: No disease of the inferior mandible was demonstrable at this date. No calcareous body suggesting salivary calculus was found; the tumor was probably malignant. On November 5, a roentgenogram was made by Dr. William Ersner, a no. 2 film, measuring 2½ by 3¼ inches being used. He demonstrated the shadow of a small stone about the size of an orange seed in the anterior two thirds of Wharton's duct (left).

Operation.—On Nov. 6, 1924, the patient was operated on, 2 per cent procaine hydrochloride being injected locally and the mandibular block technic being used. An incision was made parallel with Wharton's duct, and the stone was removed. Convalescence was uneventful. On Nov. 9, 1924, the patient was discharged, with relief from all symptoms. She was referred to Dr. Schamberg's clinic for syphilitic treatment.

On April 1, 1925, the patient returned, by request, for examination. There had been no return of the original symptoms. The results of the operation were good.

Comment.—The outstanding points in the history of this patient are: (1) the errors made in diagnosis; (2) tonsillectomy without result; (3) two negative x-ray reports, and (4) the fact that when the second roentgenogram was made, the patient was given roentgen treatment for malignant disease of the submaxillary gland.

Calculi vary in size as well as in density and are usually oval or olive-shaped if formed in the duct, but round and irregular if formed in the gland.

Bush [11] quoted a case as showing the heaviest stone on record, weighing 115 grains (7.4 Gm.), but on reviewing the literature I find that Masterman [12] reported a case of a calculus weighing 236 grains (15.3 Gm.), and 1¾ inches (4.3 cm.) long, 1 inch (2.5 cm.) wide and ½ inch (1.2 cm.) thick. It was impossible to remove the stone through the mouth with the instruments he had at hand, and he had to make an external opening. The patient gave a history of twenty-eight years' duration.

Sometimes a submaxillary calculus produces nothing more than a temporary obstruction with spasmodic pain and stasis of the secretions. Every case of calculus of the anterior two thirds of Wharton's duct does not produce symptoms of secondary infection, as demonstrated by the following history:

Case 2.—*History.*—B. H., a man, aged 41, white, American, was admitted to the Medico-Chirurgical Hospital on June 24, 1924, on the service of Dr. George M. Coates. The past history was unimportant. The patient gave a history of a swelling on the right side of the neck below the angle of the jaw, which was about the size of a lime. The swelling appeared as soon as he saw or tasted food,

11. Bush, E. R.: Indianapolis M. J. **16**:232, 1913.

12. Masterman, W. W. G.: Brit. M. J. **1**:148, 1901.

usually lasting about half of an hour after he finished his meal, although sometimes it had remained for two days. He noticed the emptying of saliva into his mouth periodically. He said that he had had these symptoms for the last eighteen years.

Examination.—A mass about the size of a lime was found in the submaxillary triangle, which was tender on pressure. By intra-oral and extra-oral palpation, a nodular mass was felt in the anterior two thirds of Wharton's duct on the right side. A small probe was passed through the duct to the point of obstruction, which was located at the posterior part of the anterior two-thirds.

On June 5, 1924, roentgen examination revealed a stone in the right submaxillary duct, and from all indications it appeared that directly in the center of the stone there was probably some foreign substance which acted as a matrix around which the calcareous deposit had grown. The patient was operated on by Dr. Coates on June 24 under ether anesthesia. An incision was made parallel with Wharton's duct and a stone removed. Two catgut sutures were used in closing the duct.

On June 28, the patient was discharged in good condition. Nine months later, he stated that he was entirely well and that there had been no return of symptoms.

Case 3.—*History.*—(Service of Dr. William Ersner.) L. N., a white man, aged 35, in 1921, had osteomyelitis of the right femur, was operated on and was well within nine weeks. In October, 1923, the patient noticed a slight stiffness in the muscles of the thigh on the right side. This caused him a great deal of concern, as he feared that it was a return of the former trouble. Six weeks later, he noticed slight pain while eating and occasionally when yawning. On Feb. 10, 1924, he consulted a dentist, had his teeth cleaned and the upper second bicuspid and first molar teeth extracted. Two days later, he began to have pain with swelling in the floor of his mouth on the right side. He returned to the dentist, who suspected Ludwig's angina.

Examination.—The temperature was 100 F.; the tonsils were inflamed. The patient wore a bar plate below. Pus was noticed coming from the floor of the mouth on the right side. Lifting up the tongue, one could see a pouched-out appearance of the entire floor which was markedly congested. The swelling and edema were so great and the pain so acute that intra-oral and extra-oral palpation were of no value. There was only a small swelling below the angle of the right jaw. Roentgen examination showed a shadow of a calculus in the anterior two thirds of Wharton's duct.

Operation.—Gas-oxygen anesthesia was used, and a stone about the size of a bean and 1 cm. long was removed. No drain or sutures were used. A mouth wash was prescribed, and the patient was discharged in ten days as cured.

Case 4.—*History.*—H. K., a white man, aged 24, was admitted to the Polyclinic Hospital on Jan. 9, 1925, in the service of Dr. R. H. Ivy, with the complaint of swelling and pain below the angle of the right jaw. The past history was unimportant. The patient first noticed the swelling about six weeks before admission while eating; since then, he had noticed that the swelling appeared frequently when he had a cold in the head. One week later, the swelling reappeared and did not reduce in size as usual. Five days later, the swelling became painful and tender to touch. There was never any sign of inflammation externally.

Examination.—On admission, the patient had a temperature of 100. Examination of the floor of the mouth showed no areas of inflammation. By intra-oral and extra-oral palpation, a small nodular mass was felt in the anterior two thirds of Wharton's duct. There was a swelling in the right submaxillary triangle, about

the size of an egg, which was tender to touch. No especial amount of trismus was noticed when opening the mouth, although there was some pain on swallowing. Roentgen examination showed the shadow of a calculus in the posterior part of the anterior two thirds of Wharton's duct.

Operation.—Under procaine hydrochloride anesthesia an incision was made parallel with Wharton's duct, and a calculus about the size of a bean was removed. A mouth wash was prescribed, and the patient was discharged on Jan. 11, 1925, in good condition.

DIFFERENTIAL DIAGNOSIS

Lymphadenitis in the submaxillary area is probably the most common condition necessitating a differential diagnosis. This is due in the majority of cases to ulceration and infection of the gums, floor of the mouth and tongue. Colp [13] stated that lymphadenitis occurs most frequently in children when their teeth begin to erupt or decay. Inflammatory conditions of the tonsils and the fauces produce an involvement of the anterior deep cervical nodes, of which the tonsillar node is the first to become affected, this being located just behind and below the angle of the jaw. As a rule, little trismus is associated with the foregoing condition.

Ivy [14] described the differential diagnosis of an acute dental abscess which frequently produces a swelling in the submaxillary triangle. "If the perforation takes place at the level of the alveolar process of the jaw, there is formed a swelling in the vestibule of the mouth with a buccal opening or an opening on the skin of the face; if, on the contrary, the perforatino occurs at the level of the body of the bone, a true submaxillary phlegmon is formed. The location of the swelling differs according to whether the outer plate, the inner plate or the lower border of the mandible is perforated." This condition, which he called osteoperiostitis, not lymphadenitis, is characterized by severe trismus. The trismus is due to the involvement of the internal pterygoid and masseter muscles with the inflammatory mass and is one of the most important points in the diagnosis of osteoperiostitis.

Carcinoma of the submaxillary gland is rare. Up to the end of 1923, there were only twenty cases on record (Bailey [4]). I have not been able to find any report of additional cases since that date. There may be a secondary infection of the submaxillary lymph nodes due to carcinoma of the tongue, gums or cheek. Every effort should be made to find the primary lesion that would clear the diagnosis.

Frequently, the infections associated with submaxillary calculus have been confused with Ludwig's angina. The latter shows a generalized cellulitis with an acute onset and is more marked in the midline under the symphysis; respiration is difficult and swallowing is more painful.

13. Colp, Ralph: Ann. Surg. **81**:611 (March) 1925.
14. Ivy, R. H.: Ann. Surg. **81**:605 (March) 1925.

Ranula is a cystic tumor occurring underneath the tongue, varying in size and having a tense, thin-walled, semitranslucent appearance. It is not usually associated with a swelling of the submaxillary gland.

Mixed tumors of the submaxillary gland can best be differentiated by roentgen examination.

Stricture of Wharton's duct following the removal of a calculus or secondary infection associated with a calculus in the duct frequently causes stenosis and chronic inflammatory enlargement of the submaxillary gland with recurrent attacks. This can best be differentiated by intra-oral and extra-oral palpation and roentgen examination.

Other conditions that give rise to swellings in the submaxillary triangle are syphilis and tuberculosis.

TREATMENT

Expectant.—A calculus in the anterior third of Wharton's duct may pass spontaneously, the only treatment required being a simple mouth wash. Due care should be taken in prescribing drugs, as any preparation containing belladonna would inhibit the flow of the secretion of the gland.

Operative.—Calculus in the anterior two thirds of Wharton's duct can best be removed under local anesthesia. It is essential first to fix the stone either by clamping the tissue below and behind the stone with a pair of tissue forceps or by fastening that part of the duct containing the calculus with a deep suture. Unless the calculus is fastened, it may slip along the canal and enter the hilum of the gland. The stone having been fixed, an incision is now made in the long axis of the duct and the stone can be removed with tissue forceps or a scoop curet, due care being taken not to crush the stone.

Extirpation of the gland is indicated in (*a*) multiple stones within the gland, associated with chronic inflammation, and (*b*) long-standing cases of obstruction due to stricture of Wharton's duct as a result of an operation or the recurrence of the calculus.

CONCLUSIONS

1. I think that submaxillary calculus is not as rare as the literature would lead one to believe, and I feel certain that the difficulties encountered in making a diagnosis warrant more space in surgical textbooks. It is not the infrequency of this condition that is overlooked, but the anatomic situation of the submaxillary gland, which is both cervical and buccal. Another reason that this condition is often neglected is that the glandular chain is so frequently imposed on by infections from the lower gums, the floor of the mouth and the tongue.

2. The symptoms are divided into subjective and objective. The subjective symptoms consist of severe pain in the floor of the mouth,

tongue and side of the throat; exaggeration of pain and increase in the swelling at the suggestion or anticipation of food; relief from pain and partial or complete disappearance of the swelling following the meal. The objective symptoms are: a circumscribed, tender swelling in the submaxillary region, varying in size and having a direct relationship to meals; by intra-oral and extra-oral palpation, an extremely tender nodule, the calculus, which may be felt somewhere along the course of Wharton's duct.

3. As submaxillary calculi are rich in mineral salts, they usually cast a good roentgenographic shadow. The calculus in the anterior two thirds of Wharton's duct can be demonstrated by using a no. 2 film (2½ by 3¼ inches) placed horizontally between the upper and the lower teeth with the sensitized side down and the rays directed beneath the chin.

4. Important points in the diagnosis are the presence of a hard tender swelling in the floor of the mouth associated with submaxillary enlargement, which varies in size from time to time, producing a pain that is collicky in character.

5. Medical and conservative and radical surgical treatment are given. Medical treatment consists of the stimulation of salivary secretion; avoidance of use of belladonna, and massage of the duct with an attempt to remove the stone, if it is in the anterior one third. Conservative surgical treatment consists of fixing the stone with tissue forceps or suture; incising the duct parallel with the long axis, and removing the stone with a scoop. Radical surgical procedures are employed when there are multiple stones within the gland, chronic inflammation of the gland, stricture of Wharton's duct or recurrence of the calculus.

Clinical Notes

PEMPHIGUS PRIMARY IN THE LARYNX*

ALBERT B. MURPHY, M.D., EVERETT, WASH.

Pemphigus involving the mucous membrane of the pharynx and mouth primarily or secondarily to its manifestation on the skin is not infrequently seen. Pemphigus involving the larynx primarily and remaining restricted to this region for a period of twelve weeks before lesions appear on the skin and mucous membrane elsewhere is a condition that has not been included in the differential diagnosis of obscure laryngeal lesions.

REPORT OF CASE

A man, aged 72, was referred to me on account of sore throat of six weeks' duration. Previous to that time he had always been well, never having had any serious illness or operation.

The family history was negative for cancer and tuberculosis, and the patient was the father of ten children, nine of whom were living and in good health.

The dysphagia of which he complained was aggravated by coughing and swallowing, and the maximum intensity was located at the level of the larynx. At times the condition improved for a few days, being helped, he thought, by the internal use of an ointment that the family physician had prescribed for external use. There was no hoarseness up to this time and no hemoptysis.

Physical examination revealed nothing important except the local condition in the throat, and some tenderness on rectal examination. No cause for the latter was determined by palpation.

Examination of the nose, nasopharynx and upper pharynx disclosed nothing unusual. On the laryngeal surface of the uvula was a superficially denuded area with a markedly hyperemic base about 1 cm. in diameter. This lesion did not have enough depth to give it the appearance of an ulcer. The vocal cords and arytenoids were normal. Under local treatment, the lesion became less painful and appeared to be healing.

The Wassermann reaction was negative, as were cultures from the nose and throat. The blood showed 7,500 white cells, 4,000,000 red cells and 85 per cent hemoglobin. No abnormal cells were seen in the blood smear.

Two weeks from the date of the first examination the patient complained of increased pain, and examination disclosed a new lesion similar to the first one, but smaller, situated on the right arytenoid. At this time, a definite bleb could be seen on the laryngeal surface of the epiglottis. The bleb ruptured before the next examination on the following day, and the denuded surface presented the same hyperemic base seen in the other lesions. When definite blebs were seen, a diagnosis of pemphigus was made.

Except for the loss of weight, which could be accounted for by the patient's inability to eat solid food, there were no new developments until six weeks from the date of the first examination, when blebs appeared first on the base of the tongue and then on the anterior surface of the chest.

* Submitted for publication, March 26, 1929.

Iodides and sodium cacodylate were given, but the patient became progressively worse, and died six months from the date of onset, after practically the entire surface of the body, as well as the nose, mouth and conjunctivae, had been involved.

COMMENT

One hesitates before adding another problem to the field of laryngeal diagnosis in which the limitations of diagnosis by inspection only are already keenly felt by most laryngologists, but the diagnosis of pemphigus is not difficult once a definite bleb is seen. It should be kept in mind that a bleb can form and rupture, leaving a simple ulcerated area in a period of a few hours, so that repeated daily observations should be made when the condition is suspected. The bullae usually burst at once, although they may remain intact for a day or two and a few may subside unruptured. The lesions in the larynx produce the hyperemic lesions resembling a superficial angioma in contradistinction to the diphtheroid patches produced by maceration of the denuded areas in the mouth.

PHENYLAMINO-ETHANOL SULPHATE IN RHINOLOGY*

PAUL T. PACE, M.D., AND JOHN A. BACHER, M.D., SAN FRANCISCO

There is an important field of usefulness in rhinology for drugs which reduce the swelling of congested or inflamed mucous membranes. Agents which constrict the blood vessels and reduce the turgescence of the mucosae thereby facilitate examination of the nose and improve its drainage. The use of ephedrine in this connection has recently been advocated, its principal advantage appearing to be that its solutions are stable (unlike epinephrine) and that it is not a narcotic (unlike cocaine). This compound, however, produces considerable irritation and swelling in susceptible patients and is, moreover, unduly expensive. A compound which appeared more promising than ephedrine was recently introduced by Miller and Piness[1] and Alles[2] under its chemical name, phenylamino-ethanol sulphate. The pharmacologic studies by Alles and by Tainter[3] showed that it constricted vessels by direct muscular stimulation similarly to ephedrine and was also stable in solution. We have therefore tested the efficiency of this compound in clinical usage, comparing and contrasting it with 1 and 2 per cent solutions of cocaine and with a 3 per cent solution of ephedrine.

Fifty cases were studied, in about half of which the patients were suffering from acute or chronic sinusitis; the remainder consisted of cases of otitis media, tonsillitis, deviated septum and other conditions. Administered by topical application or drops, the phenylamino-ethanol was applied on one side of the nose, and ephedrine sulphate or cocaine on the other. Observations were made on the rela-

---

* Submitted for publication, March 18, 1929.

* From the Department of Otolaryngology, Stanford University School of Medicine.

1. Miller, H., and Piness, G.: Synthetic Substitute for Ephedrine, J. A. M. A. **91**:1033 (Oct. 6) 1928.

2. Alles, G. A.: J. Pharm. & Exper. Therap. **32**:121, 1927.

3. Tainter, M. L.: Proc. Soc. Exper. Biol. & Med. **25**:275, 1928; J. Pharm. & Exper. Therap. **36**:29, 1929.

tive times of onset of constriction, its degree and duration, and the production of irritation by these agents.

With the use of all three drugs, shrinkage of the mucous membrane began within one minute and was at a maximum in from three to four minutes in all cases. The mucosae remained constricted for from one to twelve hours, there being no significant difference between these compounds in this respect. It was found that the 2 per cent amine solution produced as great a degree of constriction as the 3 per cent solution of ephedrine or the 2 per cent solution of cocaine. None of the patients observed burning or irritation on the side on which the amine was applied, but about 25 per cent of them complained of these symptoms from the ephedrine. Ephedrine and epinephrine often give rise to swelling and engorgement of the mucosa, which appear after the vasoconstriction has disappeared. Such a condition was never observed when this new amine was used.

The interesting additional observation was made that cocainized mucosae failed to constrict after the application of either phenylamino-ethanol or ephedrine. This is in keeping with the observations of Tainter[4] that cocaine desensitizes the circulatory apparatus to the action of this group of compounds.

Solutions kept for seven months at room temperature show the same degree of activity as when freshly made. This compound therefore shows the same stability in solution as ephedrine.

CONCLUSIONS

1. Phenylamino-ethanol sulphate constricts inflamed and congested nasal mucosae similarly to cocaine, epinephrine or ephedrine.

2. A 2 per cent solution applied locally is fully effective for routine use and produces the same rapidity, degree and duration of action as a 3 per cent solution of ephedrine or a 2 per cent solution of cocaine.

3. Its solutions are stable over long periods.

4. With this new amine, we have never observed the undesirable immediate or late irritation frequently produced by ephedrine.

5. Phenylamino-ethanol sulphate, therefore, possesses advantages over ephedrine which warrant extended trial of its rhinologic usefulness.

RHINOLITH: REPORT OF A CASE*

JAY IRELAND, M.D., CHICAGO

True rhinoliths are rare. The following case is of interest because of its long duration and the large size of the rhinolith.

CASE REPORT

C. W. Y., aged 39, married, an American, a roofer, on Jan. 12, 1929, complained of nasal trouble. This had been present since February, 1913. Since then, he had had frequent colds. Since February, 1928, he had not been able to breathe well through the left naris and since May, 1928, he had not been able to breathe through it at all. The complaints at the time of examination were swelling,

4. Footnote 3 (second reference).

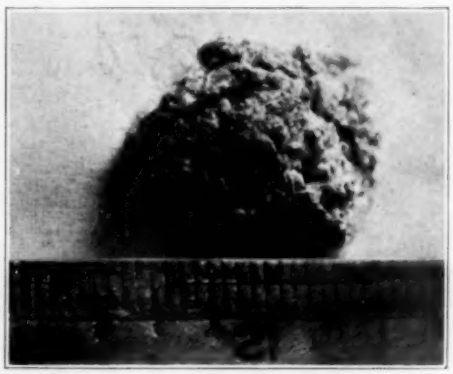
* Submitted for publication, March 8, 1929.

pain and tenderness of the left nostril, with complete inability to breath through the left nostril. He also could feel a hard object in the left naris. He breathed entirely through the right naris.

The past history was unimportant, except for a 4 plus Wassermannn reaction of the blood in August, 1928. No symptoms of syphilis were present, and the blood was examined because the wife of the patient was being treated for syphilis.

Physical examination gave negative results, except in the nasal region. The right naris was normal, except that the septum was deviated to the right. On slight dilation with the nasal speculum, the large rhinolith shown in the accompanying illustration was visible. It extended to within 8 mm. of the anterior end of the naris.

The rhinolith was removed on Jan. 12, 1929, after the patient had been given ¼ grain (16 mg.) of morphine sulphate by mouth and topical application of



Appearance of rhinolith.

2 per cent cocaine. Because of its large size, the stone had to be broken into several pieces to be removed. The parts were pasted together so that the illustration could be made. Some bleeding occurred at the operation, but it was only slight and packing was unnecessary. The patient made an uneventful recovery and on February 4 was able to breathe freely through the affected side. However, he still has colds. The stone weighed 5 Gm. It measured 3 by 2.5 by 1.5 cm. It was quite jagged on the side that touched the lateral nasal wall, where it was apparently attached to the mucous membrane. The structure was definitely laminated.

COMMENT

The etiologic factor suggested is the occupation of the patient; he had been a roofer since 1904. Since 1911, he had worked with roofing of the same composition as that which he worked with at the present. The roofing material is made of felt saturated with asphalt and embedded with slate. However, the color of the stone was much lighter than that of either the slate or the asphalt with which he worked. Also, the frequent colds perhaps contributed as an etiologic factor.

5412 North Clark Street.

MASTOIDECTOMY SUCTION TIPS*

D. H. Anthony, M.D., Memphis, Tenn.

Mastoidectomy suction tips are made in two sizes, one 6 inches (15.2 cm.) long, with a 3 mm. opening in the small end, and a small tip of the same length with a 2 mm. opening in the small end. These tips are smaller at the distal end, which prevents the tip from becoming clogged by the bone chips and blood clots. The end of the tip is smooth and bulbous. These instruments will fit the ordinary rubber suction tube.

Mastoidectomy suction tip.

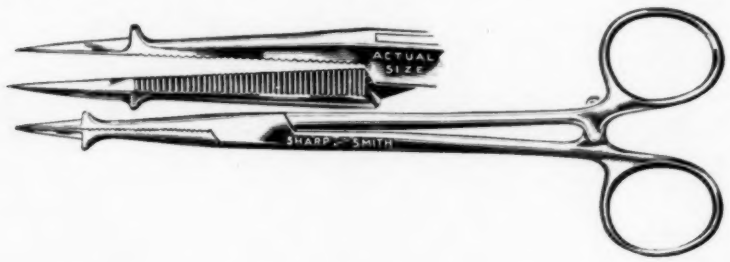
The larger instrument is used in general mastoid operations, and the smaller tip is useful in mastoids with a small antrum and in the region of the middle ear when radical mastoidectomies are performed.

This suction tip can be used in radical procedures on the frontal sinuses, in operations on the antrum, in external ethmoidectomy and also in evisceration of the eye and operations on the lacrimal sac.

SHARP GUARDED FORCEPS FOR EVACUATING PERITONSILLAR ABSCESSES*

S. J. Pearlman, M.D., and Norman Leshin, M.D., Chicago

The illustration shows forceps made of chromium plated steel, with edges sharpened and guarded at a distance of 2.8 cm. Of delicate construction, this



instrument has proved valuable for opening peritonsillar and retropharyngeal abscesses.

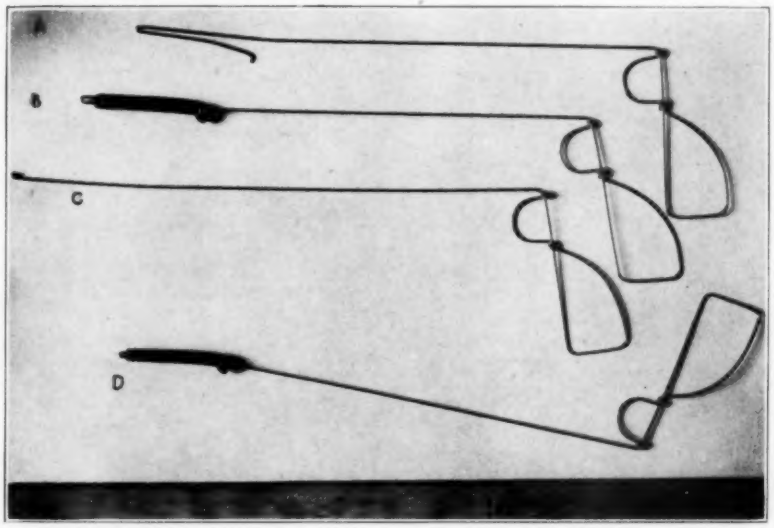
---

* Submitted for publication, March 7, 1929.
* Submitted for publication, Jan. 28, 1929.

SIMPLE INSTRUMENTS FOR DIRECT INTUBATION AND EXTUBATION*

EDMUND BOYD, M.B., TORONTO, CANADA

The instruments are constructed of ordinary steel wire, no. 14, standard American wire gage. The ends are of various lengths to fit the tubes, as shown in *B* of the illustration. For the smallest tubes, wire of smaller gage should be used.



Instruments for direct intubation and extubation.

The shaft of the extubator (*C*) is bent so that it will catch on the upper distal end of the tube. If necessary it may be disengaged by inverting and withdrawing, as shown in *D*.

The advantages claimed for these instruments are: (1) ease of manipulation; (2) flexibility of the shaft, which allows latitude in the direction of the tube, and (3) the fact that if either manipulation should be prolonged the patient can breathe easily through the tube during that time.

* Submitted for publication, Feb. 19, 1929.

News and Comment

AMERICAN BOARD OF OTOLARYNGOLOGY

An examination was held in Portland, Ore., July 8, during the meeting of the American Medical Association. Thirty-seven applicants appeared for examination; 11 per cent failed.

The next examination will be given on Monday, October 21, in Philadelphia, preceding the opening of the meeting of the American Academy of Ophthalmology and Otolaryngology in Atlantic City.

Prospective candidates for certificates should address the Secretary, Dr. W. P. Wherry, 1500 Medical Arts Building, Omaha, Neb., for proper application blanks.

Abstracts from Current Literature

Ear

DIPLACUSIS AND OTHER UNCOMMON SYMPTOMS IN OTITIS MEDIA. SEIFFERT, Ztschr. f. Hals-, Nasen- u. Ohrenh. **23**:150 (June 10) 1929.

A patient showed such an accumulation of serosanguineous exudate in the tympanic cavity, one and a half days after the beginning of otitis media, that the contents squirted through the speculum when the left drum membrane was incised. *Pneumococcus*, type IV, was found in the secretion. On the third day, the formation of air bubbles ceased, but pain increased. On the fifth day, the mastoid process was opened because the pain had become unbearable. Coagula of fibrin and, in some cells, thin pus were found. On the fifth day after the operation, the patient declared that he heard the voice of a woman with his left ear with a higher pitch, and later, than with his right sound ear, so that to the latter it sounded like an echo. The patient was musically trained. He heard a^1 as b^1, namely, half a tone higher; a^3 he heard 2 tones higher. The difference became the greater the higher the tones were; he heard f^4 almost an octave higher. The upper tone limit was diminished on both sides; it was about 15,000, according to the test with the monochord. The later hearing, diplacusis echotica, disappeared after two days. The diplacusis disharmonica lasted about three weeks. The patient observed, however, a third kind of disturbance: tones which were heard in equal pitch had different timbres. On the right side, the tunes sounded as if they came from a thick cord, and on the left, as if they emanated from a thinner cord. This disturbance lasted three weeks longer than the diplacusis disharmonica. The author states that the tones heard higher were not overtones. He assumes that the disturbance of hearing was caused by a labyrinthine complication, also, for otolith dizziness was present when the patient occupied quickly a position on his back. He became dizzy and showed rotatory nystagmus to the right. When he sat up quickly, he showed rotatory nystagmus to the left. This symptom became less pronounced in the course of weeks. It is possible that the disturbance of the inner ear was the consequence of a perilabyrinthitis. The most plausible explanation would be that a partial loss of tension of the basilar membrane had developed, so that the particular fibers did not react to the adequate tones, the fibers destined for higher tones reacting to deeper tones. The diplacusis echotica could, perhaps, be explained by the assumption that the nerve cell becomes irritated by the unfamiliar tone and reacts more slowly. In order to clear up this point, it is important to establish whether diplacusis echotica is frequently associated with a pronounced diplacusis disharmonica or whether it occurs without it.

AMBERG, Detroit.

Miscellaneous

CHONDROMA OF THE ETHMOID. PARADZIK, Ztschr. f. Hals-, Nasen- u. Ohrenh. **22**:505 (Feb. 16) 1929.

In 1925, Schlittler compiled fifty-one cases of chondroma. Since that time four other cases have been reported, while Hoffmann described a number of mixed tumors, osteosarcomas and chondrosarcomas of the upper jaw. The author cites another case of chondroma. The patient was a miner, aged 45, who did not have a hereditary tendency toward tumors. The picture in this case conforms with those described previously. A pure chondroma was attached to the ethmoid with a broad base and had grown into the maxillary antrum. The whole septum was pushed to the other side. The tumor could be diagnosed easily by its appearance, consistency and anemia. The roentgenogram was negative. This tumor grew within six months, whereas chondromas grow slowly, as a rule. They are usually found in young people. Chondromas almost always have a broad base, yet

Schlittler observed one with a polypoid stem. He removed it with one cut of the scissors. Under conduction anesthesia of the ethmoidal nerve and the sphenopalatine ganglion, and under infiltration anesthesia, in Paradzik's patient, an incision was made from the canthus of the eye in the nasolabial fold to the angle of the lip. After removal of the anterior wall of the maxillary antrum, white, shining masses presented themselves, which did not bleed and which were removed with the forceps or finger. The whole ethmoid system was filled. The wound was closed by primary suture and packed from the nose. The operation was easy, because the tumor was compact and had not grown into the orbit or the sphenoid. A permanent cure cannot be claimed after the interval of only six months at the time of the report.

AMBERG, Detroit.

CONTRIBUTION TO THE ETIOLOGY AND THERAPY OF PERITONSILLAR ABSCESSES. JAN GORNY, Ztschr. f. Hals-, Nasen- u. Ohrenh. **23**:147 (June 10) 1929.

The author has not found any mention in the literature of a case of peritonsillar abscess caused by a foreign body. He observed such a case. In a woman, aged 38, a peritonsillar abscess was opened, with only temporary relief. Gorny had observed a yellow spot the size of a pinhead on the left tonsil, about 0.5 cm. from the palatine arch. A bristle, 9 mm. long, presented itself as Gorny was investigating the surroundings of the pus collection with a closed bayonet forceps. Foreign bodies are common occurrences in the valleculae, or in the faucial or lingual tonsils, but not peritonsillar abscesses. The author reports a case of Professor Seiffert. Seiffert saw a boy, aged 12 years, who suffered from peritonsillitis. A bristle from a tooth brush, 3 cm. [?] in length, was removed. The author thinks that in similar instances tonsillectomy might be considered if there is a well founded suspicion of the presence of a foreign body which does not show itself on the surface.

AMBERG, Detroit.

Society Transactions

CHICAGO LARYNGOLOGICAL AND OTOLOGICAL SOCIETY

Regular Meeting, Feb. 4, 1929

EDWIN MCGINNIS, M.D., *President, in the Chair*

PAPILLOMAS OF THE LARYNX. DR. THOMAS C. GALLOWAY.

Dr. Galloway presented a case of papillomas of the larynx in a boy, aged 9. The condition had been diagnosed laryngeal diphtheria, and the patient was in urgent dyspnea when seen. An emergency tracheotomy was done. He had previously had three operations and from twelve to fifteen radium treatments and had not spoken above a whisper for eleven months. Treatment for papillomas had included expectant treatment, treatment with tracheotomy and intubation; radium; avulsion; excision, and diathermy as reported by Galbraith and Hubbard. Three treatments were given with the biterminal coagulation and dissection current, under suspension. There was a marked late recurrence in the tracheotomy wound, and this was removed through the old wound, working under vision through a bronchoscope through the larynx, and the base coagulated. He found with a relatively small current and a needle electrode, a rather amazing precision possible in the larynx. He believed all of the papillomas were gone, and after two months the boy had good cords and a good voice.

Another case demonstrated was apparently one of intrinsic carcinoma of the larynx in which the patient was treated by electro-coagulation after laryngofissure. Dr. Cottle had used the tissue cutting current to go through the midline soft tissues and most of the cartilage, and a superficial coagulating and desiccating current apparently destroyed the growth which involved the anterior commissure and part of each cord. There was almost no reaction, and in six days the patient swallowed normally. So far the patient had a normal airway and could be expected to have a fair voice.

DISCUSSION

DR. SAMUEL SALINGER: I do not approve of the use of radium in treating patients with papilloma of the larynx. In two cases of which I have knowledge the radium had no effect on the growths, but produced adhesions between the skin, the underlying cartilage and perichondrium, and an atresia of the trachea. I know of no case in which the patient was benefited in the least by treatment with radium. Electro-coagulation of carcinoma seems to be an ideal method, but only time can tell whether all of the growth is actually destroyed, and whether there will be secondary contractures from scar tissue. If the carcinoma is destroyed permanently and an airway can be maintained, the method may prove superior to a cutting operation.

DR. EDWIN MCGINNIS: In 1914, I treated patients with papillomas by fulguration, with fair results, but was so impressed with Dr. Lynch's method that I forgot all about the fulguration. I recently had a case similar to Dr. Galloway's, in which I operated repeatedly for recurrences, some of which were on the epiglottis. Finally I used diathermy under ether anesthesia, removing the ether from the room, and got a smooth end-result, without any evident scars and little destruction.

I also have had some experience with papillomatous formation around a tracheotomy wound, and on removal of the tracheotomy tube with the healing of the wound I pinch off the growths. I have treated one patient in this way, and the patient was able to breathe through the larynx, and there was little scarring. I followed New's procedure in two cases, and was greatly pleased with the way in which the condition healed with so slight reaction. In twenty-one days one patient was healed up and out of the hospital.

In the first cases the patients were operated on under ethylene gas anesthesia by putting in an airway through the trachea and using the Mackenty tubes.

DR. HARRY L. POLLOCK: I have tried surgical diathermy but have discarded it and resorted to surgical measures entirely. The more experience one has with laryngectomy the easier it becomes and the better are the results. In intrinsic carcinoma this operation will cure the patient, and I believe it to be the best procedure. In a case in which the growth was located on one side a laryngofissure was performed and diathermy was used a year and a half ago; the patient is still well, but the growth was small. In an operation performed this morning I used the Gwathmey synergistic anesthesia. The patient made no complaint and was in good condition at the end of the operation. I think that this method is better than a general anesthetic, particularly unless one uses the Mackenty tubes, for if the patients are awake, they can expectorate the mucus and dangerous complications can be avoided.

DR. GALLOWAY: It should be remembered that there is little scarring following electro-coagulation, perhaps less than after any other operation. We have not a large number of laryngeal cases, but from our experience with coagulation in conditions about the head, we are convinved that it offers a great deal. Local anesthesia, blocking the superior laryngeal nerve after Braun's method, has been satisfactory.

THE PATHOLOGIC SIGNIFICANCE OF DEVIATED NASAL SEPTUMS. DR. OSCAR BREITENBACH, Waukegan, Ill.

The records of large hospitals show that next to tonsillectomy, the submucous resection of the septum is now the most commonly performed operation in otolaryngology. A definite field for prophylactic achievement presents itself in connection with the many factors undermining normal respiratory function of nasal air passages. The conservation of much function, and the restoration of function, can be accomplished by the removal of pathologic processes secondary to deviated nasal septums. The apologetic attitude of many in detailing tonsil and septal pathologic changes is unnecessary. No subject in otolaryngology is worthy of greater scrutiny and more study than that of septal deviation, especially the evaluation of its pathologic changes as a definite disease factor.

The deviated septum, simulating in the minds of many an elementary subject in the practice of otolaryngology, has fostered timidity and many seem hesitant to approach this subject, because of a possible odium of mediocrity.

The cry has been raised both in and outside the ranks of otolaryngology that too many septums are being operated on unnecessarily. Many operations on the septum have been performed without well supported grounds, but considering the varied pathologic changes that a deflected septum may originate, it is not altogether improbable that many deflected septums are not operated on that should be. Statistics from both European and American sources indicate that over 75 per cent of all adults have deflected septums. They are of either developmental or traumatic origin, the former preponderating. Septums are much more commonly deviated to the left than to the right, and ballottement is to be remembered as a factor in deviation.

According to the location, the septal deflection may block the air stream to the lung, to the sinuses or to the eustachian tube and the middle ear. The pathologic processes of the respiratory tract and their definite relation to deviated nasal septums must be kept in mind. Because of the prevalence of deflected septums, special care must be taken to rule out other possible causes of the patient's complaint. Disappointment following submucous resection will occur less often if this is done. Slight deviation that is not a factor in aberrant function should be strictly left alone. Air hunger from general conditions such as anemia, pulmonary disease and myocardial disease should be kept in mind.

A plea for postoperative data in the general field of otolaryngology is made.

ACUTE SUPPURATIVE MASTOIDITIS WITH PURULENT LEPTOMENINGITIS (HEMOLYTIC STREPTOCOCCI). DR. E. W. GARDNER.

The patient, Malcomb, aged 7, was one of twin boys, both of whom were operated on the same day for purulent mastoiditis. The other twin recovered uneventfully. Both boys had had frequent attacks of purulent otitis media since childhood. In 1924, both boys had hemolytic streptococcic otitis media, bilateral. Courtney recovered following paracentesis. Malcomb had bilateral paracentesis, but later required mastoidectomy, unilateral. During the following three years (1924-1927), both boys had recurrent purulent otitis with paracentesis and recovery.

On March 4, 1927, Malcomb presented unilateral purulent otitis. The temperature was 104 F. The ear drum was incised. No culture was taken. The following week the entire family was ill with an epidemic disease of the upper respiratory tract, and the patient was seen (as the family lived in a suburb) by the family physician. The patient was again seen eleven days after paracentesis. Classic mastoid symptoms were presented: deafness, canal sagging, elevation of temperature (100 F.), white blood cells 10,500, polymorphonuclears 74, and tenderness over and below the mastoid. There was some tenderness of the neck, but no suggestion of meningitis at that time. Skiagrams were positive. There was no postauricular swelling. Operation showed a necrotic mastoid bone and the antrum filled with necrotic granulations. There was no demonstrable dehiscence of the inner table.

The following day the morning temperature was normal. At 4 p. m. it was 101.2 F. and continued between 100 and 106.8 F. until the patient's death on the sixteenth day subsequent to operation, the twenty-seventh day subsequent to paracentesis and the thirty-fourth day subsequent to the first respiratory symptoms.

The following are points of especial interest: 1. Positive symptoms of meningitis were present on the first day subsequent to operation. 2. The operative wound remained clean, but showed no reparative process. 3. The white blood cells ranged from 10,500 to 42,900; with from 79 to 98 per cent polymorphonuclears. 4. Daily spinal puncture was done with the removal of from 5 to 20 cc. of fluid. The spinal fluid cell count began at 1,100 and advanced to 9,000; the invading organism was the hemolytic streptococcus. 6. The blood culture was always negative. 7. A skiagram of the head indicated abscess of the brain posterior to the operative area; this was disproved at postmortem examination. 8. The spinal mercury manometer showed lessened permeability of the left lateral sinus (by Dr. Lewis J. Pollock). 9. The patient received, in all, 112 cc. of blood serum, by subcutaneous injection, from his mother (who had been ill with an infection identical, so far as could be ascertained, to that of the patient and whose blood, it was hoped, would be rich in antibodies beneficial to the patient). These injections produced reaction in the patient (increased temperature, once a chill, etc.), but no definite conclusion as to their value could be drawn. 10. Dr. Loyal Davis made an exploration of the brain with a needle for left temporal abscess. (Necrotic tissue, but not free pus, was found at postmortem examination.) 11. Edema of the lids, and the fundi vessels were engorged, suggesting that there was cavernous sinus thrombosis, which was not found at postmortem examination and which was probably due to the great intraventricular pressure as found post mortem.

Postmortem Observations (Dr. L. E. Hines, Pathologist, St. Joseph's Hospital).—A clot was found in the left lateral sinus; it was adherent to the wall but not occluding. Surgical defect showed no opening through the inner cranial table. The blood vessels of the brain were engorged, and everywhere there was evidence of compression of brain tissue. In sulci along the blood vessels was a yellow purulent exudate, especially over the left hemisphere. Lateral ventricles were markedly dilated, especially the left, and the linings were covered with a purulent-like exudate. The left ventricle extended posteriorly to within 1 cm. of the posterior surface. (It probably was this extension which, in the roentgenogram, was taken to be an abscess.)

Anatomic Diagnosis: The anatomic diagnosis was (1) generalized suppurative leptomeningitis; (2) marked dilatation of lateral ventricles, especially left of the

brain; (3) left suppurative mastoiditis; (4) slight thrombosis, left lateral sinus; (5) marked generalized pallor and emaciation; (6) cloudy swelling of all viscera; (7) acute splenic tumor, and (8) petechial hemorrhages of the lining of the small intestine.

One year subsequent to this, the surviving twin required mastoid drainage of the ear not previously operated on. He recovered uneventfully. The organism again was hemolytic streptococcus.

During his illness his mother said she had had a slight sore throat for several weeks. Examination showed subacute infection of the tonsil stumps. Culture showed hemolytic streptococci identical in all respects to the streptococci found in the patient's culture. She had a tonsillectomy several years prior to the birth of her boys, and had had no acute tonsillitis at any time since them. It was her habit to kiss the boys directly on the mouth. Her tonsil stumps were removed, since which time Courtney has had no recurrence of otitis media.

Drs. W. Burmeister, Wasko, Lewis J. Pollock, A. A. Hayden, Loyal Davis and L. E. Hines were called in consultation.

MALIGNANCY OF THE MIDDLE EAR, BILATERAL, WITH AUTOPSY OBSERVATIONS. DR. E. W. HAGENS, collaborating with DR. G. E. SHAMBAUGH.

The patient sought medical aid on account of stuffiness in the left nostril, and this case is of interest because the patient was observed over a period of six years. Tissue was removed from the left side of the nose and proved to be epithelioma. Radium was applied and the tumor disappeared. After several years the patient noticed tinnitus in the left ear, and examination revealed a tumor mass in the upper part of the cavum tympani, shining through the drum membrane. Application of radium did not affect the tumor development. The hearing tests showed mainly a defect for the upper part of the tone scale on that side, and practically normal reactions on the right side. The vestibular mechanism was intact.

Later, stuffiness recurred on each side of the nose. Tumor tissue was seen on both sides in the ethmoid region, and sections were again made from the left side. Dr. Le Count reported epithelioma. The tumor tissue disappeared from the nose a second time on the application of radium. The patient next noticed fulness in the right ear, and tumor tissue was seen shining through the lower portion of the drum membrane. From this time on until her death (from another cause) she complained of increasing stuffiness of the ears, tinnitus, deafness, attacks of vertigo and dryness of the nose. Facial paralysis on the left side was noted, but the patient did not complain of it. The hearing tests showed gradual increase in deafness on both sides, especially the left, until little was heard in this ear. The vestibular tests gave increasingly diminishing responses.

The gross examination of the right temporal bone did not show any outward evidence of tumor, but on the left side several masses of tumor tissue had broken through the tegmen tympani, and what was left of the middle ear cavity was filled in by tumor masses.

Microscopic examination of the right temporal bone revealed extensive tumor invasion of the cavum tympani up to the level of the epitympanic space. There was slight invasion of the bony capsule about the cochlea. For the rest, and particularly the cochlea and vestibular end-organs, no tumor invasion was noted. The sections from the left temporal bone showed extensive infiltration of the bony labyrinth, and extension of the tumor into the utricle, the cristae of the canals and the cochlear duct at its beginning in the vestibule. The saccule and most of the cochlea were free from the invasion. The region of the seventh nerve was replaced by tumor masses.

The tumor was fairly vascular and gave a papillary appearance under the microscope. The sections from the nose appeared similar to those from each ear. Those from the ear appeared most like that of a basal cell carcinoma. It is probable that the tumor extended by direct growth from the nose backward and outward into each ear. The article is accompanied by a number of photomicrographs.

PROSTHETIC AIDS IN RECONSTRUCTIVE SURGERY ABOUT THE HEAD. DR. FRANCIS L. LEDERER.

I wish to consider only those cases of the true reconstructive type, namely, those in which there is a total or subtotal loss of parts.

Syphilitic nasal destruction is usually classified in three degrees: (1) the saddle nose, in which the saddle is confined to the bridge; (2) a nose in which the tip is retracted upward or to one side, due to loss of mucous membrane as well as of the bony and cartillaginous support, and (3) destruction, partial or total, of all the nose (lining, structure and skin).

The cosmetic reconstruction of first degree, and in most instances of second degree, syphilitic nasal deformities, has on the whole yielded satisfactory to the variety of technics employed today. The repair of third degree syphilitic destruction of the nose has been more difficult than deformities due to other causes, because of the devitalization produced in the area attacked and also because of the disturbed circulation in neighboring tissue. Covering the parts with skin is an improvement over the original deformity, but the success of such endeavors is apt to be overestimated by the operator without considering the psychology of the patient.

Success in reconstructive cases has been only temporary, and too often the result at the end of surgical endeavor was deformity replaced by monstrosity.

I have been disappointed in the net results of my painstaking endeavors and in a measure feel guilty for having subjected my patients to operations which not only entailed a great economic loss and suffering on their part, but in many instances jeopardized their health and lives.

Both the congenital and the acquired type of complete or partial absence of the auricle has occupied my attention for a number of years. Careful and painstaking attention has been given a rather large group of these cases, and I found that the result of this labor has been most discouraging. Van Dijk comments on the absence in the literature of reports of cases in which the entire auricle has been reconstructed by surgical measures. I have only to refer him to the work of Beck who on innumerable occasions has published reports of cases embodying work of supplanting an entire auricle. Van Dijk has reached the conclusion that the loss of an entire ear seldom occurs. He also stated that the aural appendage is not cosmetically essential in women, as they are able to hide their deformity completely under their hair. I find, however, that regardless of sex, the desire for replacement of the parts is true in practically every instance. A few years ago Beck described clearly the need of correcting deformities because of certain vital psychologic factors, which were so important to keep the person in his or her social sphere.

Van Dijk, at the end of the series of operative procedures, was not satisfied with the final result. He found the ear too bulky, not sufficiently erected and the fossa scaphoidea and the antihelix not built up, and he planned in his next case to get the ear more erect through implants of cartilage, giving it more of a shell-like appearance. This supports my conclusions that in a large number of cases in which I had an opportunity in each instance to improve my technic, I could not shape an ear to resemble a normal ear, but replaced it by means of a bulk of misshaped tissue.

I am indeed indebted to my former association with Dr. Joseph Beck, for having given me an impetus, as well as in a large measure for having furnished the clinical material for this work and for the splendid cooperation I have had at all times.

For a number of years, during which total deficiencies of the nose and ear also were corrected by surgical measures, certain physiologic, anatomic and economic factors were often presented which made it necessary to use some form of prosthesis in these cases in the form either of hard rubber or of some light metal. I found these objectionable for many reasons, viz., the cost of manufacture was high (they were of such material as was easily broken or bent and would frequently have to be made over); the color to match the neighboring skin was

difficult to obtain, and if finally it did match, the color would come off; the prosthesis would in most instances have to be fastened by a heavy spectacle frame; and, lastly, but of great importance, the replaced part always had a stiff, artificial appearance that attracted as much attention as did the original deformity.

When I went to Paris, I was impressed by an observation made in a theater of international fame in which dolls of a flexible rubber material were being sold. It occurred to me then that the material appeared so elastic as to be invaluable in prosthesis. Much to my gratification, I found that at the University of Berlin a similar type of material was being utilized in the manufacture of face prostheses. Credit must be given the late Professor Adolph Passow, who, at the suggestion of Warnekros in 1913, induced his laboratory technician, Klocke, to work out such a method of producing artificial ears and noses. The procedure has been perfected by Klocke, and I feel sure that these prostheses comply with all the demands which can be made on such substitutes. They are not expensive, are easily made and possess a desirable elasticity and durability. I employ a dental laboratory technician who takes care of most of the time-consuming detail work, and it is recommended that one who has experience in doing prosthetic work should work in conjunction with the physician. No doubt as this method becomes better known, there will be modifications on modifications. I am constantly working to attain an even more satisfactory material than I have at present, and perhaps in the future a perfect formula will be attained.

It is far more difficult to replace by prosthesis parts of ears, for example, than to replace the part in toto, but it has been my experience that these patients will not consent to having any remaining part removed by surgical procedures. It is therefore necessary, in many instances, to cover useless lobules and folds of skin that could well have been eliminated. In such cases, the prosthesis has not been made without its critical points, but at least the patient's desires have been complied with. While mechanical appliance will not take the place of nature, by this method many persons can be relieved of untold embarrassment, suffering and economic loss.

Regular Meeting, March 4, 1929

EDWIN MCGINNIS, M.D., *President, in the Chair*

CARCINOMA OF THE LARYNX. DR. T. C. GALLOWAY.

Dr. Galloway qualified his enthusiasm of the preceding meeting in regard to the treatment for carcinoma of the larynx, and stated that the patient whose case was reported at that time developed a follicular tonsilitis, followed by bronchopneumonia and death. Postmortem examination revealed a carcinomatous involvement of the left side of the larynx which was inoperable, even by laryngectomy. The patient had shown no evidence of recurrence during life, but at necropsy a large mass was found below the epiglottis which was definitely malignant, and some other material from the larynx was doubtful.

One thing in favor of the method was that there was no denuded cartilage left, there was little destruction and the area had healed with a rather smooth scar throughout, but the outcome was disappointing, and he felt that he had overestimated the value of the method. Replying to a question he stated that the hyoid had not been split, but he felt that it should be done in such an extensive case.

DISCUSSION

DR. G. W. BOOT: I should like to mention the case of a patient under my care in whom the condition apparently was limited to the right vocal cord. I split the larynx with the radio knife, and found outside in the median line at the cricothyroid junction a growth which looked like a gland, but which microscopic examination showed to be carcinoma.

Dr. Robert H. Good: Referring to a patient with carcinoma of the vocal cord now in the hospital, this case was identical to the pictures Dr. Mackenty showed at the last meeting. A growth was removed from the right vocal cord, and histologic examination revealed a papilloma with indications of carcinoma, as reported by two laboratories. Dr. Mackenty said that if two laboratories reported carcinoma the patient should be operated on. I observed the patient for six weeks after removal of the papilloma and could see three nodules appear on the cord which grew rapidly. I then decided to destroy the right vocal cord with diathermy, using a Heslinger pharyngoscope.

The patient was able to breathe well following operation, but a few weeks later there was recurrence in the thyroid cartilage; I then decided to do a laryngectomy. Examination of the specimen removed showed involvement of the entire right side of the thyroid. The patient did well following laryngectomy, but the use of diathermy at the first operation did not prevent the recurrence of the growth.

Dr. Joseph C. Beck: In most cases, the use of diathermy is simply a laryngectomy without taking away the larynx, and if the cartilage is not completely destroyed, a recurrence may not be prevented. Two years ago I performed a laryngofissure for a patient about 40 years of age and destroyed a big papilloma, which was suspected of being carcinomatous, by means of diathermy, but I am not sure that it was not a case of pachydermia of the larynx. Dr. Galloway is to be complimented on the specimen presented, because it added another truth.

Referring to the case reported by Dr. Boot, it is common to find a gland at the junction of the thyroid and cricoid cartilages before one opens the larynx. However, it is not always malignant.

Dr. G. W. Boot: A papilloma in a patient past 40 years of age is almost invariably carcinomatous. If this growth is destroyed by diathermy, one does not destroy the patient with pneumonia, as so often happens with a laryngectomy.

Dr. Alfred Lewy: In the case I observed with Dr. Galloway the unoperated area of the mucosa was perfectly smooth at the time of operation, and there was no palpable gland so far as we could discover. I believe that this case proved that it is impossible to find all of the carcinomatous involvement. I still consider diathermy a good method for a strictly intrinsic growth, but I think that it is difficult to prove which patients should be treated in this way.

Dr. Edwin McGinnis: A patient on whom I had done a total laryngectomy returned with a recurrence in the glands of the neck. I believed that if Dr. Galloway and Dr. Lewy had done a laryngectomy, they would probably have missed the carcinomatous glands in their case.

Dr. George W. Boot: A young Mexican boy, whom I have seen recently, had a fight with another Mexican, who shot him. One bullet went into the left nares, through the septum and lodged in the right spenoidal sinus, and was removed through the right nares.

Outlining the Maxillary Sinus by Injection of Iodized Poppy Seed Oil, 40 per Cent Under Pressure. Dr. Walter Theobald.

The object of this paper is to present the method and results of filling the maxillary antrum with opaque solutions for the purpose of distinctly outlining gross hyperplasias, polyps, cysts and malignancies, and does not include the sphenoid, frontal and ethmoid sinuses.

The method used by me consists of a complete air displacement of the antrum by injecting iodized poppy seed oil, 40 per cent with a syringe, under pressure. After cocainizing the middle meatus, a cannula with a filled syringe is introduced by way of the natural or accessory opening into the antrum. There is always enough room around the cannula for the escape of air and injected fluid. The head is then tipped to the side so that the vertical anterior posterior plane of the head becomes horizontal, or parallel to the floor, thereby causing the affected antrum to be the dependent one, and its natural ostium uppermost. In this position a mixture of equal parts of iodized oil and olive oil is slowly injected to the point of overflow,

from 3 to 7 or 8 cc. sufficing. The patient is not allowed to change the position of the head until two x-ray pictures are taken, an anteroposterior view with the x-ray beam placed horizontally, and a lateral view taken from above with the vertical beam. The stereoscopic plates do not always prove of great value. When injection by way of the natural ostium fails, a trocar introduced into the inferior meatus, with proper fittings for the syringe, may be used, but the other procedure is successful in from 85 to 90 per cent of the cases. Care should be taken to have all connections fitted perfectly, so that no oil will escape and the antrum will become positively filled by pressure. No untoward effect has been observed from the use of iodized oil. The simple procedure of irrigating the antrum after the opaque solution is used obviates possible complications.

This procedure visualizes the extent to which an antrum may be completely or incompletely filled. The thickness of the mucosa is at once noted by measuring the distance from the bony outline of the cavity to the outline of the opaque fluid. It may appear as a simple thickening of the mucosa, or show an irregular outline pictured as indentations caused by polypi and granulation tissue. The results have been satisfactory when two different views are taken, and the conclusions in a number of cases examined have been substantiated by the microscopic observations at the time of operation. Several cases are reported.

DISCUSSION

Dr. Joseph C. Beck: I followed the work of Dr. Theobald and was much impressed with the proof that filling defects can be shown well with opaque mediums. Several years ago, I experimented with bismuth and with iodine ointment or pastes by injection into the antrum and other cavities, but found this was not a good thing to do, for I could not wash out the antrum afterward and make the studies I wished to make. I have not used iodized oil extensively and am not particularly enthusiastic about its value. I think that one can visualize what is going on in the cavities from the appearance of the roentgenogram and from the results of the clinical examination, and on operation one sometimes finds a polypoid condition in the antrum. Dr. Theobald's experience with many cases and his specimens proved that this condition occurs more often than is thought.

I believe the question of removing the mucous membrane from the antral cavity entirely to allow regeneration of the membrane remains to be proved. It has been demonstrated experimentally on dogs but not on human beings, and I am skeptical of its value.

I wish to call attention to the recent work of Dr. Hickey of Ann Arbor in bringing out tissue details by long distance radiography. Dr. Hickey places the patient from sixty to ninety inches from the tube and gives a much longer exposure than is usually given at contact photography, the time depending on whether he wishes to bring out details of soft tissues or more dense ones. The method is successful in showing the details within the thorax, and if it could be utilized for work about the head, it would be superior to any kind of injection for demonstrating a filling defect. I believe, however, that much more will be heard of the use of iodized oil, as work with it is just beginning.

Dr. John A. Cavanaugh: In 1920, I read a paper at a meeting of the Illinois State Medical Society on the injection of barium in buttermilk and later the use of barium in malted milk. Since then I have done a good deal of work with iodized oil and have also continued the use of barium in malted milk, which I think gives better detail and outlines and is not so subject to fallacious interpretation as the results from iodized oil. In a case injected recently, after the needle was introduced, serous material kept flowing from the cannula, so I introduced iodized oil under pressure. This gave a picture of the maxillary sinus filled with small globules. I then cleaned this out and injected with barium in malted milk, and a much better definition was obtained. I am not sure as to the value of injections of iodized oil, yet I feel that continued perservance along this line might uncover something worth while.

DR. A. A. HAYDEN: I am of the opinion that it makes no difference how far the light is from the sinus, but that it makes all the difference in the world how far the x-ray plate is from the sinus. A light across the room will give as clear a reflection as if it were nearer.

DR. EDWIN MCGINNIS: At a recent clinic in Boston one of the clinicians in filling the antrum plugged up the opening with cotton and then injected the iodized oil under pressure.

I should like to cite the case of a patient I had under observation, whose physicians had been searching for focal infection. Her tonsils were removed, and she was then referred to an oral surgeon. He pulled an upper molar and curetted the cavity, and got into what he thought was the antrum, which he treated by irrigation and curettage. The patient did not improve and was referred back to the oral surgeon. She finally came to the surgical department, where a catheter was passed, the cavity being filled with iodized oil; this revealed the fact that the patient had a large misplaced ethmoid cell.

DR. WALTER H. THEOBALD: I agree with what Dr. Beck said about operating on an antrum and presuming diseased tissue present when the mucous membrane is normal, or nearly so. In some cases I have found the mucous membrane a little thickened but not sufficiently so to justify a radical operation. By means of the opaque substance one can show to his satisfaction when the mucosa is thickened, or when the antrum contains a polyp or foreign growth.

It is not possible to show all of the inner lining of the antrum by means of the endoscope. I have seen the inside of an antrum from two to five years after operation and considered the lining to be normal mucous membrane, because no discharge was coming from the antrum. In other words it was believed to be a cured case.

I believe that the distance of the light from the patient makes no difference. The beam of light is always placed the same distance away from the patient for each exposure.

In the case mentioned by Dr. Cavanaugh the antrum was probably fairly well filled with polypi, and the iodized oil was not injected under sufficient pressure to fill the spaces between them correctly. When an injection was made the second time, it showed the crypts between the polypi. In one of my cases at the time of irrigation a flaky material was washed out that had the appearance of cholesteatoma, and when the picture was taken it showed the antrum nearly filled with a growth.

RETROPHARYNGEAL ABSCESS OF OTITIC ORIGIN. DR. SAMUEL J. PEARLMAN.

Retropharyngeal abscesses of otitic origin are not seen often; however, there must be a number which remain unrecognized. The anatomic routes by which pus from the external and middle ear and from the mastoid reach the retropharyngeal space are devious and complicated. A retropharyngeal abscess may arise from a furuncle of the external canal which invades the parotid space and then spreads to the retropharyngeal space; it may take its source from an extradural abscess of the middle or posterior cranial fossa. It may arise from an otitis media and attack the retropharyngeal lymph nodes by way of the lymphatics. They are all of great interest and should be more carefully studied.

DISCUSSION

DR. EDWARD P. NORCROSS: In a case which was under observation five or six years ago, the other symptoms overshadowed a retropharyngeal abscess. The condition recurred several times, disappearing after a radical mastoid operation was performed.

DR. JOHN A. CAVANAUGH: I think that Gruber's idea of the anatomic defects of the glaserian fissure is logical and more plausible than many of the other causes given.

DR. SAMUEL SALINGER: The histologic proof was really the most conclusive in these cases, and Dr. Pearlman had had at least one opportunity of proving the route by which the abscess reached the retropharyngeal space. In the case seen with Dr. Pearlman at postmortem examination the tip of the petrous bone was entirely necrotic and bathed in pus. The pathologist on inserting his finger in the nasopharynx found a distinct bulging which corresponded to the necrotic area of the petrous bone. Had the patient lived a little longer it would have been possible to determine the condition clinically. The postmortem examination made it evident that the necrosis of the tip was working the infection downward toward the postnasal space.

DR. LOUIS OSTROM, Rock Island, Ill.: I wish to mention the case of a patient I saw with Dr. G. L. Eyster some years ago for whom I removed a fish bone from the lower end of the esophagus. Two or three days later the patient complained of sore throat, which developed into a double otitis media and double mastoiditis with complete necrosis of both mastoid tips, with marked edema of the tissues in the neck which looked as though they would necrose. Profuse discharge, more than could be accounted for, lasted for several days after operation. When a large, long probe was used, it passed into the neck, anterior to the cervical vertebrae, and came out on the other side of the neck through the other mastoid wound. Gauze packing was put in extending through the neck. The patient also had nephritis. He finally returned to his home in Chicago and the ultimate outcome was not known. This infection undoubtedly pursued the retropharyngeal path, as described by Dr. Pearlman.

DR. JOSEPH C. BECK: I should like to recall a case that I reported before this Society some twenty-five years ago in which when I irrigated one ear the water came out through the other. That was definitely a case of necrosis extending through one of the routes described by Dr. Pearlman. I also saw a case with Dr. Mundt some five years ago of a paratonsillar abscess complicating mastoiditis. The function of the labyrinth was destroyed, but there appeared to be no connection with the suppurating ear. There was some evidence of an extradural complication. In that case an incision was made for a paratonsillar abscess, but on digital examination a retropharyngeal abscess was found. The patient died, but no necropsy was obtained to prove the route of the infection. Several years ago I reported a case of Bezold's mastoid, and at that time stated that the routes of infection were those described by Cunningham. At present I have a case of retropharyngeal abscess, in a child who was brought in from Wisconsin with this acute condition. When the abscess was punctured the thin, chalky white pus spurted out over the patient's face. The patient was running a high temperature, even after operation, which I felt was due to the associated involvement of the lymph gland, but it might also be due to some organic complication.

PHONETICS IN RELATION TO OTOLARYNGOLOGY. DR. G. OSCAR RUSSELL.

Let us summarize the reasons for the unusually sharp, and more complete laryngeal view just demonstrated through the perilaryngoskop and *fonofaryngoskop*, manufactured per my specifications by the E. S. I. Co., Rochester, N. Y.

1. The so-called retracted or fallen epiglottis cannot be manifest during pronunciation of a clear vowel *"ee"* (*i* as in *peep*), for as the tip moves back toward the wall of the pharynx, the quality shades off into an *"uh"* (*u* as in *cut*), or *"ah"* (*a* as in *calm*).

2. Therefore, any instrument permitting the subject to pronounce a clear and unhindered *"ee"* makes it possible for the examiner to inhibit retracted epiglottis interference—provided always that gagging or other extraneous disturbance does not inject itself.

3. This vowel also distends the lower part of the pharynx the most, brings the tip of the epiglottis as far anterior as possible, likewise relaxes the posterior pull on the cushion of the epiglottis and its approximation with the cartilages of Wrisberg.

4. If pitched conveniently high, and the voice quality is free flowing (i. e., not constricted or strident, nasal, or guttural), one gets the maximum glottal lip view. Even the anterior commissure is laid bare, and one sees well up under the cushion, getting also a much wider lateral view under the ventricular bands.

5. But a clear unhindered *"ee"* cannot be produced when the ordinary laryngeal mirror is used, nor with any lens system in a straight tube larger than a pencil in diameter. Hence the *cystoscopes, autophonoscopes, broncoscopes, endoscopes,* and other like instruments fail to give the complete view. For to pronounce this vowel clearly, subjects regularly force the tongue up against the full length of the hard palate, forming a narrow arched tube through which a view of the back part of the pharynx cannot be had. And if the buccal cavity is forced open, the vowel changes in quality toward *"eh"* (*e* as in *pep*), (*c* as in *cut*) or *"ah"* (*a* as in *calm*), thus leading at the same time to their subconscious posterior closure of the epiglottis.

6. The perilaryngoskop being but 3 mm. in diameter avoids all such difficulties, and gives a wide-angle view of the interior larynx and surrounding pharynx simultaneously. At the same time it may, if dexterously handled, eliminate the reflex causes of gagging. Hence it permits an examination in subjects heretofore thought impossible.

7. Gagging constricts the ventricular bands; it likewise approximates the cushion of the epiglottis and cartilages of Wrisberg. As a reflex, it is Nature's way of keeping foreign substances out of the larynx; hence it is aroused when the interior larynx is touched by any hard body, if extraneous contact is made or force brought to bear on the epiglottis to keep it from closing, or even if the back velum is touched, or pressure brought to bear on the tongue in order apparently to force an entrance into those sensitive precincts.

With either the perilaryngoskop or fonfaryngoskop, these are reduced. The lens of the first makes it possible to get a clear view of the whole interior larynx (since it permits a clear vowel *"ee"*), when the distal end is even from 20 to 30 mm. from the pharyngeal wall. And it need not touch the velum, much less the epiglottis. The front tongue is free to move at will; hence the psychologic impression of entraneous force is eliminated.

The fonofaryngoskop is much larger, and hence does only the last. But it gives a much brighter image and a view of more of the interior larynx and cords than can be had with an ordinary laryngoscope. And the autofonofaryngoscop has the advantage of permitting physicians, subject, relatives, students, or others in the room (if desirable) to see the view simultaneously.

DISCUSSION

DR. ELMER L. KENYON: I wish to express my appreciation of the valuable work being done by Professor Russell. Prior to fifteen years ago laryngologists believed that the vocal cords worked by one mechanism and the mouth by another. Now it is known that when one produces a vocal tone the muscles of the mouth, neck and the vocal cords act as one unit. Dr. Russell's instruments make it possible to see what occurs in the larynx for each individual sound, the first time this has been possible, and this possibility constitutes an important turning point in the understanding of laryngology, so far as the production of speech sounds is concerned. I am interested to know that the deafened child and adult could be handled in the way that had been described. Not long ago I spent a day in a state institution for the deaf, where there was all kinds of teaching, but so far as I could find out, no cognizance was taken of the fact that a child might be able to hear. I feel that through Professor Russell's conception of the employment of residual hearing, the teachers in schools for the deaf could be brought to accept more scientific methods.

I have been studying the extrinsic muscles and my work dovetails almost perfectly with that of Professor Russell's studies of intrinsic laryngeal action. It was prophesied long ago that the vocal cords would be found to have a distinct apposition for each of the principles of sound production, and this statement is being

verified by Professor Russell's studies. In my work to improve the hearing of the deaf, I have worked only with those who had no hearing, while Professor Russell has worked with those who retained a slight amount of hearing. I have found that a study by the patient of the movements of the thyroid cartilage of the larynx is capable of becoming an effective substitute for the hearing in attempting to guide the speech apparatus to normal voice attainment. If an adult loses his hearing, almost inevitably his voice becomes markedly altered but in the way mentioned he had been able to change a very high pitched, strained voice back to normal. I am sure that otolaryngologists will realize the value of the work being done by at least one of the men who work with disorders of speech.

DR. E. W. HAGENS: In the examination of the school children in the state institutions it was found that, in the audiometer charts where they used the *2A*, the hearing these children had was either below 2,000 vibrations or above and below both. No children were found who had a remnant above 2,000 alone. Two charts were used which give the relation of hearing in respect to the speech defect. One chart is arranged on the basis of marked speech defect, and one with practically normal speech. They realize that a child may come in with a bad speech defect and improve after a time, so their tables probably had some defects.

In comparing the tuning fork tests with the audiometer it was found that the audiometer picked up some remnants that the tuning forks missed, and I believe the audiometer is more valuable in this way, for the remnants can be placed more definitely. In the Pittsburgh school one person said he could feel the 256 and 128, but there was no rubber cap over the piece, which he believed accounted for it. It has been found that the type of hearing loss cannot be diagnosed from the audiometer records. I believe that Professor Russell's chart would be of much aid to the teachers and the children. In some of the schools the teaching was poor, but in some it was scientific, and those in charge were using all the methods possible and making use of all the hearing the child had. In some institutions an apparatus is used that magnifies the voice, whereas previously the children had been taught by the alphabet method. In other schools the oral method is insisted on entirely. I believe that with Professor Russell's system it should be possible to teach much more effectively and scientifically.

DR. ALFRED LEWY: According to Professor Russell's statement it would be simple to produce an instrument that would amplify in any desired pitch and damp in others. So far as I know there is no instrument on the American market at present that amplifies higher tones without amplifying the low ones. Such an instrument would be desirable for the cases of inner ear deafness in which the patients are not helped by the present telephone apparatus, which is better suited for those patients whose deafness is largely for low tones. Dr. Lewy has made this suggestion to engineers of the Bell Telephone Company, but nothing has come of it. Dr. Flatau presented an instrument before the German Otolaryngologic Congress which it is claimed damps the low tones and amplifies higher ones and is suitable for inner ear deafness. I do not know whether or not this instrument is small enough to be practical. Could Professor Russell throw any light on this subject?

DR. ROBERT SONNENSCHEIN: I wish to express my gratitude to Professor Russell for his address and for the demonstration of the apparatus. I think that the speaker was a little pessimistic regarding the functional tests of hearing. So far as testing with speech is concerned, in dealing with persons with only small remnants of hearing, it is difficult to get a fair idea of the state of the hearing, but in ordinary practice the use of speech is most important, for the criterion of the efficiency of the ear is its ability to understand the human voice. It is practically impossible to standardize the human voice, but if one accustoms himself to using the residual air, and makes the tests in the same room with the same furniture, etc., thus getting the same systems of waves, and the same reflection of sounds, a fairly accurate test is made. The intensity of sound varies inversely to the square of the distance, but this applies to sound generated in the open.

In considering whether a person has marked impairment of hearing, the use of the whispered voice is of great aid. It is difficult to obtain any pure sound even with a tuning fork. With the average tuning fork the first overtone sound has a frequency about five or six times that of the fundamental. Nevertheless, with the simple expediency of placing weights on the forks, as shown by Bezold, or using rubber bands, one can secure practically a pure tone. If present at all, the overtone will not disturb the patient.

Referring to the duration of vibration of tuning forks, unless one strikes them hard, there will be only slight variation. If one knows the "constant" of decrement or damping, and strikes the fork in a uniform manner he can, as Fletcher has shown, by means of that "constant" determine the loss of hearing in sensation units just as with the audiometer. While many criticisms may be offered concerning tests of hearing, the principal tests used uniformly will give practical and valuable results.

DR. AUSTIN A. HAYDEN: I should like to ask Professor Russell if he routinely examined the larynx with a laryngeal mirror and a tongue depressor at the same time. The patient usually holds his own tongue with a bit of gauze and no depressor is used.

I believe that a forward step has been made in the exact analysis of the location of deafness in the tone scale, and I feel that the various electric hearing aids have acted largely as "shotgun prescriptions." The entire tone range has been magnified, without out any regard for the particular pitch in which the patient heard the most, and for that reason a great deal of the effort of these instruments is lost. If the building up could be centered, as Professor Russell pointed out, at that particular pitch in which the patient has hearing, the results would be improved. I am glad to find that the work at the Ohio State University is in accord with the teaching of Dr. Kenyon.

I believe that the practical part of the science of phonetics can be summed up in few words: 1. The removal of nasal and throat obstructions will help only a few of the persons with defective speech, and when any operation is done on the nose and throat with the idea of improving the speech, unless it is a definitely obstructive defect, one is treading on dangerous ground. 2. Every otolaryngologist should equip himself with the name, address and telephone number of a speech specialist, for he has not the time or inclination to do this work properly himself. I believe that the autofonofaryngoscope will be found to be the most useful of Professor Russell's instruments, for it not only allows the examining physician to view the interior of the larynx but permits the patient or a student to see the larynx, and it has the further possibility of having its image projected on the screen. By making a small adjustment of this instrument the larynx and its adnexa can be seen in their normal size, whereas with the autoperilaryngoscope there is a much smaller image of a much larger field.

PROFESSOR G. OSCAR RUSSELL: In the cases of deafness which were cited the patients showed an uneven loss which was greatest for the higher areas. If one amplifies enough for the subject to hear the high frequencies, the result will be an overpowering distortion of the lower. For this reason it would be necessary to create an apparatus which would balance the whole by amplifying the high proportionately more than the lower frequencies. That would be possible, but as instruments now run the result would be cumbersome to say the least.

I agree with Dr. Hayden that the fonofaryngoskop is by far the best all-around laryngoskop of the five I have developed, for the reasons Dr. Hayden cited. It would be less expensive; it injects neither spherical nor chromatic aberration, likely to result in lens systems; it shows a strongly lighted area; it is more nearly natural in size, and when the autofonofaryngoskop is used, it makes it possible for a large number of people to see the same thing at the same time.

On the other hand the perilaryngoskop has many distinct advantages which I do not feel need to be resummarized.

Regarding the hearing tests, I hope it is clear that I was distinguishing sharply between the customary ones used by physicians in order to orient themselves in

their diagnosis, and one the diagnostic implications of which were primarily to guide the patient and his teacher. I do not mean to imply that the whisper and tuning fork tests do not have their advantages. But some test should be made which will give a sound spectrum analysis which will serve for pedagogic diagnostic purposes—one that will serve to guide the patient in his learning, relearning or learning retention process; and give him a psychologic reassurance which I feel is necessary in order to keep the patient from developing the well known "deaf attitude of mind." The latter would have to be taken with some such instrument as the Western Electric 1-*A* or 2-*A* audiometer. (The 3-*A* or 4-*A* would not do.) If one considered the happiness which might be brought into the lives of these patients by such means, many times the expense of the apparatus would be justified. I hope that otologists will come to agree that no patient should be released without such a chart to guide him as that which I have just presented. If every physician cannot afford an audiometer, I suggest that (as for bacteriologic reports) the examination be arranged from some central bureau of trained specialists.

Regular Meeting, April 1, 1929

EDWIN MCGINNIS, M.D., *President, in the Chair*

PRESENTATION OF PATIENTS.

DR. G. W. BOOT presented a patient who was admitted to Cook County Hospital on Jan. 14, 1929, in a drowsy condition. He had complete paralysis of both eyes for external motion and almost complete loss of internal motion, but vertical motion of the eyes was preserved. He had some difficulty in naming objects. The left ear was discharging and a left mastoiditis was present. The left mastoid was exenterated, the left temporosphenoidal lobe exposed and 1½ ounces of pus evacuated from the temporosphenoidal lobe. The patient was much emaciated at the time of operation. He had recovered much of his weight, and there was almost perfect motion of the eyes in all directions.

DR. SAMUEL J. PEARLMAN presented a case of suppurative labyrinthitis following an acute exacerbation of a chronic otitis media with complicating symptoms of generalized meningitis ending in recovery.

R. L., a white man, aged 30, entered the Cook County Hospital on March 2, 1929. He gave a history of having had a chronic bilateral suppurative otitis media since early childhood, with an acute exacerbation in the left ear during the past four days, and presented on admission the picture of a full fledged meningitis which had apparently been present for about forty-eight hours. There was rigidity of the neck, bilateral Kernig sign, severe headache, nausea and vomiting. He had pain on pressure over the left mastoid. He had in addition a well marked nystagmus toward the right. Both ears were discharging freely, the left more than the right, and the discharge was foul. There was no positive fistula test in either ear, and the hearing was reduced to *ad concham* in the right ear and altogether gone in the left. Douching the left ear with hot water did not reverse the nystagmus. Spinal puncture revealed a turbid spinal fluid under markedly increased pressure with positive Pandy and Ross-Jones reactions. The cell count was 29,000, chiefly leukocytes. Smears of the spinal fluid and cultures were negative. The Wassermann reaction was negative. An examination of the blood revealed a white count of 23,000 per cubic millimeter and the hemoglobin was 95 per cent. The spinal puncture was repeated practically daily and within nine days the cell count was reduced to 400 cells with a great improvement in all symptoms. The nystagmus, however, and the deafness persisted. On the sixteenth day after admission, when the patient was apparently well, he developed a facial paralysis on the left side. For a few days before this he had complained of a good deal of night pain in the region of the left mastoid. A radical mastoid operation was done at this time and revealed a small sequestrum in the horizontal

semicircular canal, freely movable but not surrounded by granulations. This was not disturbed. Improvement was rapid and continuous after the operation.

In a recent discussion before the Scottish Society of Otology and Laryngology, Dr. J. S. Frazer summarized his opinion with regard to meningeal complications of suppurative ear conditions. He stated that those cases of meningitis in which no organisms were demonstrable in the spinal fluid did best; that when organisms could be demonstrated in smears from the spinal fluid but could not be cultured, those patients sometimes recovered, but that when organisms could be demonstrated both in the smear and in cultures from the spinal fluid, the prognosis was almost uniformly fatal.

DISCUSSION

DR. SAMUEL SALINGER: I saw both of these patients at the Cook County Hospital. In the case of the boy with the abscess of the brain, there was considerable doubt as to whether there was an abscess, and if so, on which side, as both ears were discharging with equal severity. No focal sign could be found with the exception of bilateral rectus paresis, which was difficult to explain on the basis of a tumor in one part of the cerebrum. I believe that the aphasia must have been transitory, or apparent only at times, for I experienced no difficulty in having the boy recognize different coins. The case demonstrated well how by persistence in questioning and frequent examination one can elicit a symptom on which the entire diagnosis may depend.

The case reported by Dr. Pearlman was also interesting, as some authorities assert that when there is a suppurative labyrinthitis and meningitis, the indications are to open the labyrinth, while others disagree with this dictum. In this case I have felt that as long as the boy's condition was improving it was proper to wait, as there was evidence that the process was walling off. I knew that the patient would require a mastoid operation, but thought it would be best to wait until the labyrinthine symptoms cleared up. In the meantime the patient developed a facial paralysis, which to me was an indication that the bony necrosis was extending. A radical mastoid was promptly done, the facial paralysis disappeared and recovery was complete.

DR. J. HOLINGER: Was the dura pulsating in the case of the abscess of the brain, and was there much serous fluid?

DR. BOOT: The dura did not pulsate, and I have never seen the dura pulsating in any abscess of the brain. The boy had over 100 cells in the spinal fluid and a positive Kernig sign. During the last two months I have seen two such cases, one following scarlet fever and the other an acute suppurative mastoiditis. Each had between 1,800 and 1,900 cells per cubic millimeter of spinal fluid.

Directory of Otolaryngologic and Ophthalmologic Societies *

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SECTION ON LARYNGOLOGY, OTOLOGY AND RHINOLOGY

Chairman: Dr. William V. Mullin, Cleveland Clinic, Cleveland.
Secretary: Dr. Gabriel Tucker, Bronchoscopic Clinic, University Hospital, Philadelphia.
Place: Detroit. Time: 1930.

AMERICAN BRONCHOSCOPIC SOCIETY

President: Dr. Thomas E. Carmody, Metropolitan Bldg., Denver.
Secretary-Treasurer: Dr. Louis H. Clerf, 128 S. 10th St., Philadelphia.

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. Charles W. Richardson, 1337 Connecticut Ave. N. W., Washington, D. C.
Secretary: Dr. George M. Coates, 1721 Pine St., Philadelphia.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY

President: Dr. Hill Hastings, 1136 W. 6th St., Los Angeles.
Secretary: Dr. R. L. Loughran, 33 E. 63d St., New York.

AMERICAN OTOLOGICAL SOCIETY

President: Dr. J. Gordon Wilson, 104 S. Michigan Ave., Chicago.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Harris P. Mosher, 828 Beacon St., Boston.
President-Elect: Dr. William H. Wilder, 122 S. Michigan Ave., Chicago.
Executive Secretary: Dr. William P. Wherry, Medical Arts Bldg., Omaha.
Place: Atlantic City, N. J. Time: Oct. 21-25, 1929.

LOCAL

Los Angeles County Medical Society, Section of Ophthalmology and Otolaryngology

President: Dr. Harold S. Muckleston, 6422 Hollywood Blvd., Los Angeles.
Secretary-Treasurer: Dr. J. Frank Friesen, 1208 Roosevelt Bldg., Los Angeles.
Place: California Hospital, assembly room. Time: 8 p. m., first Monday of each month.

The Colorado Oto-Laryngological Society

President: Dr. Frank L. Dennis, Ferguson Bldg., Colorado Springs.
Secretary: Dr. Rex L. Murphy, Metropolitan Bldg., Denver.
Place: Assembly Room of Metropolitan Bldg. Time: First Saturday of each month from October to May.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and to keep it up to date.

Medical Society of the District of Columbia, Section on Ophthalmology and Oto-Laryngology

Chairman: Dr. Louis S. Greene, 1710 Rhode Island Ave. N. W., Washington.
Secretary: Dr. R. E. Gookin, Medical Science Bldg., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month.

Atlanta Academy of Ophthalmology and Otolaryngology

President: Dr. H. F. McDuffie, 45 Edgewood Ave., Atlanta, Ga.
Secretary: Dr. Leon E. Brawner, 157 Forrest Ave. N. E., Atlanta, Ga.
Place: Academy of Medicine, 38 Prescott St. N. E. Time: 8 p. m., last Thursday of each month.

Chicago Laryngological and Otological Society

President: Dr. Samuel Salinger, 25 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Austin A. Hayden, 25 E. Washington St., Chicago.
Place: Grill Room, Stevens Restaurant, 16 N. Wabash Ave. Time: 6 p. m., first Monday of each month from October to May.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. Robert J. Masters, Hume-Mansur Bldg., Indianapolis.
Secretary: Dr. Kenneth L. Craft, Hume-Mansur Bldg., Indianapolis.
Place: University Club. Time: 6:30 p. m., second Thursday of each month from October to May.

New Orleans Ophthalmological and Otological Society

President: Dr. M. Earle Brown, Maison Blanche Bldg., New Orleans.
Secretary-Treasurer: Dr. W. A. Wagner, Pere Marquette Bldg., New Orleans.
Place: Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., third Thursday of each month from September to June.

Baltimore City Medical Society, Section on Otology and Laryngology

Chairman: Dr. Waitman F. Zinn, Medical Arts Bldg., Baltimore.
Secretary: Dr. Moses L. Breitstein, 1212 Eutaw Pl., Baltimore.
Place: 1211 Cathedral St. Time: 8:30 p. m., last Friday of each month.

New England Otological and Laryngological Society

President: Dr. Harris P. Mosher, 828 Beacon St., Boston.
Secretary-Treasurer: Dr. Charles T. Porter, 520 Commonwealth Ave., Boston.

Detroit Oto-Laryngological Society

President: Dr. C. C. McClelland, David Whitney Bldg., Detroit.
Secretary-Treasurer: Dr. Don A. Cohoe, 13535 Woodward Ave., Detroit.
Place: Maccabees Bldg. Time: Third Wednesday evening of each month from October to May.

Kansas City Society of Ophthalmology and Otolaryngology

President: Dr. L. R. Forgrave, Logan Bldg., St. Joseph, Mo.
Secretary: Dr. A. E. Eubank, Argyle Bldg., Kansas City, Mo.
Time: Third Thursday of each month from September to May. The November, January and March meetings are devoted to clinical work.

St. Louis Ear, Nose and Throat Club

Acting President—Senior member of the executive committee: Dr. E. T. Senseney, Lister Bldg., St. Louis.
Secretary: Dr. V. V. Wood, Humboldt Bldg., St. Louis.
Place: University Club Bldg. Time: Third Wednesday in February, April, October and December.

Omaha and Council Bluffs Ophthalmological and Otolaryngological Society

President: Dr. Charles M. Swab, Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. J. C. Davis, 1615 Howard St., Omaha.

Academy of Medicine of Northern New Jersey, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Frederick J. Wort, 1080 Broad St., Newark.
Secretary: Dr. Earle LeRoy Wood, 31 Lincoln Park, Newark.
Place: 91 Lincoln Park South. Time: 8:45 p. m., second Monday of each month.

New York Academy of Medicine, Section of Laryngology and Rhinology

Chairman: Dr. David H. Jones, 114 E. 54th St., New York.
Secretary: Dr. Edward Frankel, Jr., 152 W. 58th St., New York.
Place: 103d St. and 5th Ave. Time: 8:30 p. m., fourth Wednesday of each month from October to May.

New York Academy of Medicine, Section of Otology

Chairman: Dr. Clarence H. Smith, 2 E. 54th St., New York.
Secretary: Dr. James Garfield Dwyer, 57 W. 57th St., New York.
Place: 103d St. and 5th Ave. Time: Second Friday of each month from October to May.

Eastern New York Eye, Ear, Nose and Throat Association

President: Dr. John P. O'Keefe, 251 State St., Albany.
Secretary-Treasurer: Dr. Arthur F. Holding, 142 Washington Ave., Albany.

Rochester Eye, Ear, Nose and Throat Society

Chairman: Dr. Frank Barber, 75 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Cecil B. Hert, 29 N. Goodman St., Rochester, N. Y.
Place: Rochester Medical Association, 13 Prince St. Time: 8 p. m., third Monday of each month from October to May.

Cincinnati Oto-Laryngological Society

President: Dr. Harris H. Vail, 24 E. 8th St., Cincinnati.
President-Elect: Dr. Edward King, Pearl Market Bank Bldg., Cincinnati.
Secretary-Treasurer: Dr. Donald Lyle, 19 W. 7th St., Cincinnati.
Place: University Club. Time: 6:45 p. m., second Tuesday of each month from October to May.

Cleveland Academy of Medicine, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Myron Metzenbaum, Rose Bldg., Cleveland.
Secretary: Dr. A. D. Ruedemans, Euclid and E. 93d St., Cleveland.
Place: Winton Hotel. Time: Fourth Friday of each month.

Pacific Coast Oto-Ophthalmological Society

President: Dr. Arthur C. Jones, 105 N. 8th St., Boise, Idaho.
Secretary-Treasurer: Dr. Walter F. Hoffman, 817 Summit Ave., Seattle.

Philadelphia Laryngological Society

President: Dr. Henry A. Laessle, 13th and Spruce Sts., Philadelphia.
Secretary: Dr. Herman B. Cohen, 13th and Spruce Sts., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., first Tuesday of each month from October to June.

College of Physicians of Philadelphia, Section on Otology and Laryngology

Chairman: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Clerk: Dr. Frederick M. Strouse, 13th and Spruce Sts., Philadelphia.
Place: College of Physicians. Time: 8:30 p. m., third Wednesday of each month from October to June.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. William Thornwall Davis, 927 Farragut Sq., Washington, D. C.
Secretary: Dr. Fletcher D. Woodward, Box 162, University, Va.
Place: Miami, Fla. Time: Nov. 20-22, 1929.

The Memphis Society of Ophthalmology and Oto-Laryngology

Chairman: Each member, in alphabetical order.
Secretary: Dr. R. O. Rychener, Exchange Bldg., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. Herschel Ezell, Doctor's Bldg., Nashville, Tenn.
Secretary-Treasurer: Dr. W. W. Wilkerson, Jr., Bennie-Dillon Bldg., Nashville, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month.

Dallas Academy of Ophthalmology and Otolaryngology

President: Dr. D. L. Bettison, Medical Arts Bldg., Dallas, Texas.
Executive Secretary: Dr. W. Mood Knowles, Medical Arts Bldg., Dallas, Texas.
Recording Secretary: Dr. L. A. Nelson, 4105 Live Oak, Dallas, Texas.
Place: Dallas Athletic Club. Time: 6 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. C. P. Schenck, Medical Arts Bldg., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Needham, Fort Worth National Bank Bldg., Fort Worth, Texas.
Place: University Club. Time: 6:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Eye, Ear, Nose and Throat Section

President: Dr. John H. Foster, 1300 Walker Ave., Houston, Texas.
Secretary: Dr. Edward W. Griffey, Houston Clinic, Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., first Thursday of each month from September to June.

San Antonio Ophthalmolo-Oto-Laryngological Society

President: Dr. F. H. Roseborough, 302 Moore Bldg., San Antonio, Texas.
Secretary-Treasurer: Dr. William D. Gill, 323 Medical Arts Bldg., San Antonio, Texas.
Place: Bexar County Medical Library. Time: 8 p. m., first Tuesday of each month from October to May.

Virginia Society of Otolaryngology and Ophthalmology

President: Dr. H. B. Stone, Roanoke.
Secretary-Treasurer: Dr. Fletcher D. Woodward, Box 162, University.

PUGET SOUND ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

President: Dr. Will Otto Bell, Medical-Dental Bldg., Seattle.
Secretary-Treasurer: Dr. Francis A. Brugman, Medical-Dental Bldg., Seattle.
Time: 8 p. m., third Tuesday of each month, except July and August.

SPOKANE ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. O. M. Rott, Paulsen Bldg., Spokane, Wash.
Secretary: Dr. C. A. Veasey, Jr., Spokane, Wash.

THE MILWAUKEE OTO-OPHTHALMIC SOCIETY

President: Dr. L. P. Allen, 145½ Main St., Oshkosh, Wis.
Secretary-Treasurer: Dr. Edward R. Ryan, 425 E. Water St., Milwaukee.
Place: University Club. Time: 6:30 p. m., third Tuesday of each month.

THE ARCHIVES OF OTOLARYNGOLOGY is published by the American Medical Association to stimulate research in the field of laryngology and otology, and to disseminate knowledge in this department of medicine.

Manuscripts for publication, books for review, and correspondence relating to the editorial management should be sent to Dr. George E. Shambaugh, Editor-in-Chief, 122 South Michigan Avenue, Chicago, or to any other member of the Editorial board. Communications regarding subscriptions, reprints, etc., should be addressed, ARCHIVES OF OTOLARYNGOLOGY, American Medical Association, 535 North Dearborn Street, Chicago.

Articles are accepted for publication on condition that they are contributed solely to the ARCHIVES OF OTOLARYNGOLOGY. Manuscripts must be typewritten, preferably double spaced, and the original copy should be submitted. Zinc etchings and halftones of illustrations will be supplied by the publisher when the original illustrations warrant.

Footnotes and bibliographies should conform to the style of the Quarterly Cumulative Index Medicus, published by the American Medical Association. This requires, in order given: name of author, title of article, name of periodical, with volume, page, month—day of month if weekly—and year. A complete list of abbreviations for standard periodicals, together with a full discussion of the style of the A. M. A. publications, appears in The Art and Practice of Medical Writing, a comprehensive book on the preparation of medical manuscripts, published by the American Medical Association. Price, $1.50.

Matter appearing in the ARCHIVES OF OTOLARYNGOLOGY is covered by copyright, but, as a rule, no objection will be made to its reproduction in reputable medical journals if proper credit is given. However, the reproduction for commercial purposes of articles appearing in the ARCHIVES OF OTOLARYNGOLOGY, or in any of the other publications issued by the Association, will not be permitted.

Authors will receive one hundred reprints free; additional reprints may be obtained at cost.

The ARCHIVES OF OTOLARYNGOLOGY is issued monthly. Annual subscription price (two volumes): Domestic, $6.00; Canadian, $6.40; foreign, $6.75, including postage. Single copies, 75 cents, postpaid.

Checks, etc., should be made payable to the AMERICAN MEDICAL ASSOCIATION.

OTHER PERIODICAL PUBLICATIONS
of the American Medical Association

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION—Weekly. Covers all the medical sciences and matters of general medical interest. Illustrated. Annual subscription price (two volumes): Domestic, $5.00; Canadian, $6.50; foreign, $7.50. Single copies, 20 cents.

ARCHIVES OF INTERNAL MEDICINE—Monthly. Devoted to the publication of advanced, original clinical and laboratory investigations in internal medicine. Illustrated. Annual subscription price (two volumes): Domestic, $5.00; Canadian, $5.40; foreign, $5.75. Single copies, 75 cents.

AMERICAN JOURNAL OF DISEASES OF CHILDREN—Monthly. Presents pediatrics as a medical science and as a social problem. It includes carefully prepared collective abstracts based on recent pediatric literature, abstracts from foreign and domestic literature, book reviews, society transactions, etc. Illustrated. Annual subscription price (two volumes): Domestic, $5.00; Canadian, $5.40; foreign, $5.75. Single copies, 75 cents.

ARCHIVES OF DERMATOLOGY AND SYPHILOLOGY—Monthly. Devoted to advancing the knowledge of and progress in cutaneous diseases and syphilis. Publishes original contributions and full abstracts of the literature on these two subjects, transactions of the important dermatological societies, book reviews, etc. Illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

ARCHIVES OF NEUROLOGY AND PSYCHIATRY—Monthly. A medium for the presentation of original articles on nervous and mental diseases, with abstracts from foreign and domestic literature, book reviews, society transactions, etc. Illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

ARCHIVES OF SURGERY—Monthly. Devoted largely to the investigative and clinical phases of surgery, with monthly reviews on orthopedic and urologic surgery. Well illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

ARCHIVES OF PATHOLOGY—Monthly. A periodical devoted to the publication of original contributions in the field of pathology, with abstracts from foreign and domestic literature, book reviews, the transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): Domestic, $6.00; Canadian, $6.40; foreign, $6.75. Single copies, 75 cents.

ARCHIVES OF OPHTHALMOLOGY—Monthly. Includes original articles on diseases of the eye, abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): Domestic, $8.00; Canadian, $8.40; foreign, $8.75. Single copies, 85 cents.

QUARTERLY CUMULATIVE INDEX MEDICUS—Quarterly. A complete subject and author index to the worth-while current medical literature of the world. Issued four times a year. Second and fourth volumes bound for permanent reference. Subscription price, calendar year: Domestic, $12.00; Canadian, $12.50; foreign, $12.75.

AMERICAN MEDICAL ASSOCIATION

535 North Dearborn St. CHICAGO

CONTENTS

PAGE

Traumatic Conditions of the Ear in Workers in an Atmosphere of Compressed Air. Harris H. Vail, M.D., Cincinnati 113

Pathologic Changes in Tonsils: A Study of Ten Thousand Pairs of Tonsils, with Special Reference to the Presence of Cartilage, Bone, Tuberculosis and Bodies Suggestive of Actinomycosis. H. Fielding Wilkinson, M.D., Rochester, Minn..... 127

The Relationship of Sinusitis and Bronchiectasis. Lester H. Quinn, M.D., and Ovid O. Meyer, M.D., Madison, Wis. 152

Radium Therapy in Atrophic Rhinitis with Offensive Odor (Ozena). Louis Hubert, M.D., and G. Allen Robinson, M.D., New York..... 166

Acute Infectious Mononucleosis from the Point of View of an Otolaryngologist. William O. LaMotte, M.D., Wilmington, Del..... 171

Calculus of the Submaxillary Gland and Duct. Fred E. Hamlin, M.D., M.Sc. (Medical), Roanoke, Va..... 177

Clinical Notes:

Pemphigus Primary in the Larynx. Albert B. Murphy, M.D., Everett, Wash..... 188

Phenylamino-Ethanol Sulphate in Rhinology. Paul T. Pace, M.D., and John A. Bacher, M.D., San Francisco 189

Rhinolith: Report of a Case. Jay Ireland, M.D., Chicago 190

Mastoidectomy Suction Tips. D. H. Anthony, M.D., Memphis, Tenn..... 192

Sharp Guarded Forceps for Evacuating Peritonsillar Abscesses. S. J. Pearlman, M.D., and Norman Leshin, M.D., Chicago..... 192

Simple Instruments for Direct Intubation and Extubation. Edmund Boyd, M.B., Toronto, Canada..... 193

News and Comment..... 194

Abstracts from Current Literature..... 195

Society Transactions:

Chicago Laryngological and Otological Society..... 197

Directory of Otolaryngologic and Ophthalmologic Societies 212